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INTRODUCTION

IT HAS BECOME INCREASINGLY CLEAR in the last few years that an adequate description of the growth and development of the human organism requires consideration of many aspects of that phenomenon. In the past, growth of abilities and skills has been well recognized; similarly the growth of physical structures. But there are other aspects. The last issue of the REVIEW on this subject (December 1941) included a chapter on "Social and Emotional Development." This issue attempts to extend the field further.

As a result of studies such as those of Jack and others in child psychology and the more careful investigations in social learning, evidence has been accumulating during the past ten or fifteen years, demonstrating that experiences change or modify the course of personality growth. Hence, if the discussion of the development of the human personality is to present a picture that is comprehensive and functional, it must give adequate attention to the effects of a wide variety of experiences upon growth.

There is another emphasis that has become increasingly important. An "ability" as measured and identified by presentday methods is not the same as the *use* of the ability under varying conditions of motivation. One can conceive of behavior as involving among other things a combination of motive and ability. In addition to a discussion of abilities, therefore, emphasis should be given to the development of motivation.

It also seems that the growth of physiological functions is an important area. A description of the growth of physical structures is not the same as an analysis of the growth of physiological functions. One may ask such questions as: "Does the baby at birth possess a mechanism for regulating body temperature that is as effective as that of the adult?" "What is the nature of the endocrine changes that take place during the growth cycle, and what is the effect of various conditions on these changes?" "Is the digestive system capable of producing enzymes of the same quality and strength at birth as later?" These are but a few samples of the questions that a discussion of physiological functions suggests.

The present issue on "Growth and Development" attempts to include the dynamic physiological and personality aspects of development as well as the more usual ability and structural aspects.

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CHAPTER I

Personality and Motivation

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PERSONALITY, as the term is commonly used by American researchers, refers to the motives, attitudes, traits, habits, mechanisms of defense and adjustment, appetites, and aversions that combine to determine a person's molar behavior. Since these characteristics of the person are, in turn, largely determined by his experience, any account of their origin must refer to (a) the learning process, (b) motivation, and (c) the environmental conditions under which motivated action, and the consequent learning, occurs.

Until adequate theories of learning and motivation were available, and until usable techniques were developed for measuring children's motivation and the environmental conditions of learning, personality analysis was bound to be a somewhat hit-or-miss procedure. Over the past dozen years, however, Hull (16) and his colleagues have developed a comprehensive theory of adaptive learning that appears to be unusually useful for the understanding of the details of personality development. The necessary step of applying Hull's rather abstract principles to the molar behavior of social human beings was taken by Miller and Dollard (21) in *Social Learning and Imitation*. The first five chapters of this book presented an admirably clear statement of the theory of adaptive learning.

On the motivational side, two developments are worthy of emphasis. Altho Freud had made some attempt to derive complex adult motives from the simpler libidinal urges, the lack of either a learning theory or satisfactory empirical data had stultified the effort (cf. the concept of sublimation). Shaffer's (28) analysis, based primarily on theoretical premises, has received essential confirmation from recent animal research, and has been largely incorporated in the broader learning theory described by Miller and Dollard. From the standpoint of theory, therefore, both learning and motivation have passed beyond the stage of speculation, and the contemporary researcher on personality development has effective frameworks within which he can work.

As for measurement, the projective technics described by Murphy (23) in her review of three years ago, have proved more and more useful. The detailed interpretation of doll play has only begun to be standardized, but this is clearly the next step, and in the meantime the clinical understanding of such behavior has reached a high degree of effectiveness for a number of investigators.

Quite aside from such efforts to measure directly the child's motivational characteristics, there has been a vigorous attempt to define the antecedent conditions of certain motives. Mowrer's theoretical analysis of anxiety (22) and the experimental studies of frustration from a number

of laboratories have given point to this procedure. In effect, it represents the statement of hypotheses concerning the relationship between either immediate stimulus conditions or life history events and the motivational consequences of these.

None of these developments has fallen strictly within the latest three-year period; all are the culmination of researchers' efforts to discover theoretical frameworks and methodological tools with which to attack problems of personality development. Within any given period, certain theories and methods appear to predominate and to color the investigations published. In the early 1920's, personality tests were being developed and a loose kind of trait theory pervaded the writings of the day; later the iconoclastic research of May and Hartshorne gave rise to a specific-habit point of view; the early 1930's brought emphasis on "the whole child" and longitudinal interpretations of behavior. Research of the present period is by no means solely dominated by the developments in learning theory, but much of it can best be understood from that perspective.

Social Conditions of Personality Development

One of the most significant trends in recent research has been that toward analysis of the social conditions under which various attributes of behavior are developed. The early studies of such anthropologists as Mead and Malinowski, and the later interpretations of anthropological data by Linton and Kardiner, were designed to throw light on the differences in personality characteristics created by life experience in cultures that differed with respect to not only adult mores and folkways but also methods of child rearing. Without a comprehensive learning theory, these investigators were forced to turn to Freudian theory for variables to examine. Thus much of their interpretation related to the differential development of sex behavior and affectional relationships between children and adults.

In his study of the Kwoma (New Guinea), Whiting (36) carried the analysis of a primitive culture a step forward by examining the sources of motivation (drives) utilized by adults in the training of children. These were of two general kinds: the reduction of anxiety, pain and discomfort, and the providing of appropriate gratifications. Whiting observed for eight months the treatment of young children by their mothers, as a participant-observer, and during that time did not record any instances of the use of punishment with children below the age of three years. Above that age, punishment was used not infrequently.

Whiting has emphasized a point too often ignored in observations on our own cultures: that every interaction between two persons must inevitably modify in some degree the response potentialities of each. He describes the rewarding or punishing used by one person on another as teacher behavior; the relationship between the two is therefore a teacher-pupil one. The consequence of this approach to interpersonal actions is

that the observer's eye is necessarily focused on the more permanent changes in behavior that result from social contact. This is essential, of course, if the aim of an investigation is to chart the causative factors in the development of personality characteristics.

Altho Whiting's report gave in great detail the conditions of learning that create certain forms of anxiety, aggression, and ethical standards, it suffered from a lack of cross-cultural reference. It is interesting to know the exact details of the developmental sequence in which a child learns to avoid strangers, to know, for instance, that the chief reinforcement used is the reduction of anxiety originally created in an altogether different social context (avoidance of poison berries), but this fact would gain immeasurably in importance if there were comparable studies of stranger-avoidance in other cultures.

In one connection, however, no cross-cultural reference is needed. The problem of fear of sorcery has not previously been analyzed in terms of the reinforcements which sustain it. Altho sorcery may seem far removed from the life of American children, it belongs to the general class of beliefs in nonrealistic dangers. Such fears are regrettably common in the children of any culture. Whiting's observations suggested that a combination of the following factors was responsible among the Kwoma:

a. *Stimulus generalization from real dangers*—Adults evoke memories of the pain induced by objective injuries.

b. *Imitation*—Children learn to model their behavior after older persons, because such imitation leads to rewards or avoidance of punishment; this imitation is blindly continued in connection with defense responses against sorcery.

c. *Operation of chance*—The Kwoma's world is full of real dangers, and actual injury occurs often enough in conjunction with talk about supernatural dangers to avoid the completely negative relationship which would be necessary for extinction of the beliefs.

d. *Social punishments*—Since the hostile activity of supernatural agents would bring disaster to the whole community, real social punishments are inflicted on those who break taboos. This is an additional source of reinforcement for the anxiety attached to such actions.

For the most part, Whiting did not try to differentiate the Kwoma personality characteristics from those of other cultures; his concern was primarily that of discovering the specific conditions antecedent to specific actions. An alternative approach, one that stems more directly from those of Mead and Kardiner, is to examine one culture against the implicit norm of others in order to discover what attributes of it give rise to the outstanding personality characteristics of its people. For this purpose, the personalities must likewise be evaluated against comparative data on other groups.

Campbell (5) performed this task with the Negroes of St. Thomas Island. Observation of adults showed that the outstanding personality characteristics were insecurity, suspiciousness, egocentricity, and motivation toward self-aggrandizement. Altho the adult environment typically enhances dissatisfaction and frustration because of its limited economic resources, Campbell found that the home environment of childhood was

peculiarly fitted for the development of the noted traits. The poor economic status and the tenuous marital relationships created a "total situation . . . distinguished by insecurity and a lack of dependable, protective, social relationships."

On a single descriptive dimension of personality, but with a more objective technic, Engle and Engle (12) compared the children of Amish and non-Amish parents. The Amish group was known to require much greater obedience to the authority of the parents, and the Amish children proved to be more submissive and introverted on an objective personality test. They showed equally good adjustment.

These studies exemplify the effort to examine the nature of reinforcements and frustrations *as related to specific kinds of behavior*, in order to account for the development of personality characteristics that may be either unique to the individual or common to the members of a particular culture. Two of the studies cited relate to cultures foreign to our own, but the problem and the method are relevant to any culture. Further, the examination of such relationships is not limited to cultures *in toto*, but as in the Amish study, is the fundamental procedure being followed, whether intentionally or not, in any correlative study of childhood environment and personality. Parent-child and teacher-child relationships are but special cases of the larger problem.

Social Class Comparisons

In any single culture there appear to be certain consistent differences in the personalities of people belonging to different social classes. Until recently, however, it has been difficult to find objective technics for differentiating the classes; the most frequently used has been that of dividing the total population into arbitrary economic levels. Davidson (9) secured extensive data, including Rorschach records, on 102 children nine to twelve years old, with IQ's between 120 and 200, who ranged widely over the socio-economic scale. She found no relationship between income level and general personality adjustment, inferiority feelings, or a large number of other characteristics. There was a relationship with possession of fears.

These rather negative findings may have resulted from the fact that economic level is not perfectly correlated with social status or social class membership. As defined by Warner and Lunt (35), status position is measured in terms of association between members of the group. It is between these subgroups, virtually subcultures, that similarities of motivational structure seem clearest. Appel (1) found that desire for possession of property more frequently led to aggression among underprivileged than among middle-class nursery-school children. The adult motivations of the social group were very early reflected in the children's behavior. While this was probably a function of the home environment in large part, Warner, Havighurst, and Loeb (33) have shown clearly that class distinctions are reflected pervasively thruout the public-school systems of the country. Differential treatment of children leads to rewards and punishments for

different kinds of behavior on the part of lower- and middle-class children. Hence there is continuing differentiation not only in aggressiveness, but in the myriad social motives that depend for their development on consistent treatment from the social environment.

The most detailed studies of class correlates of personality have been among the Negroes. The pioneering life history analyses of Negro children from lower, middle, and upper classes by Davis and Dollard (10) have been followed by other studies initiated thru the American Council on Education (14, 17, 32, 34). The detailed findings cannot be summarized here; in general their data were exemplary rather than critical. But it is worth emphasizing again that where specific connections have been made between the status position of children (or adults) and their motivations or attitudes, the connections have been explicable in terms of the conditions of learning, i.e., of the kinds of people who rewarded or punished children's behavior on the basis of whether that behavior was suitable for adjustment in the social environment of which the adults were a part.

Insecurity

Insecurity is an ambiguous term; it may be used loosely to refer to both responses and stimulus conditions. A person may be said either to behave insecurely, or to behave in such-and-such a way *because* of insecurity. In the latter usage, the term refers to failure on the part of the environment to provide the necessary conditions for gratification of the "security systems," or motivations, of the person (cf. Kardiner, 18). In such case it refers, in effect, to a stimulus situation, or what has been described above as a *condition of learning*. There are two aspects of these problems on which data have been reported.

Considered as a reaction, insecurity has always been difficult to measure. A rating scale for preschool children was devised by Prichard and Ojemann (24) which may make the task simpler. They found five behavior patterns (withdrawal, nonacceptance, bidding for attention, hyperactivity, and apprehensiveness) that differentiated between groups of secure and insecure children. These patterns were objectively describable as to both actual behavior and conditions of occurrence. Validation of these reliable scales was based on teachers' judgments.

As objective measures of this kind are developed, it will undoubtedly prove easier to attack the question of what causes insecurity reactions. Two approaches to the problem were the studies of Arsenian (2) and Shirley (30). In both, observations were made of the behavior of children under stimulus conditions that could be defined as interfering with the normal motivation of children to be with their mothers or with friendly adults while in a strange place. Motivational systems that depend for their ultimate gratification on the affectionate cooperation of other persons are security systems; interference with them, that is, removal or absence of the necessary social-person who serves as a "tool," is by definition the stimulus condition *insecurity*.

Arsenian compared the reactions of children eleven to thirty months old, who were placed in a strange room, the youngsters of one group being accompanied, and of the other group unaccompanied, by the mother. From running descriptions of the subsequent behavior, a set of categories representing different degrees on a security-insecurity scale was devised. The children who were left alone in the room scored much lower in security than did those whose mothers were present. After five sessions on alternate days, half the children in each group were transferred to the other for the next five sessions. Altho the now unaccompanied children immediately became (in terms of the categories of insecurity reaction) even more insecure than were those who had been unaccompanied from the beginning, the children who were shifted to the accompanied group did not show any material increase in the direction of security. It appears that the insecurity reactions were evoked readily by insecurity stimulation even after several sessions of security stimulation, but that the room itself had become a stimulus to insecurity reactions for those who had had several sessions of insecurity stimulation. This difference in the degree of permanence of effect of the two kinds of stimulation is similar to that observed in experiments on the effects of artificially induced success and failure: A previously successful subject can easily be made to feel failure, but it is difficult to make a previously failing subject feel successful.

Shirley (30) likewise created a scale for the measurement of insecurity reactions. The stimulus situation used for a large group of children aged two to five years was that of being without the mother during an entire day of testing and examining at a child research center. The measures of security reaction were applied to the children's behavior at the time of each of five examinations during the day, and were repeated at six-month intervals. Shirley found that age, sex, and health were unrelated to degree of security shown. Analysis of the mothers' relations to their children, however, showed that approximately a quarter of the mothers were either oversolicitous or rejective. In comparison with the total group of children, these overdependent or rejected children showed definitely lower degrees of security in response to the insecurity stimulation.

These studies have demonstrated the feasibility of measuring insecurity reactions objectively and have shown their relation to insecurity stimulation. The Shirley investigation went a step further and demonstrated the influence of a social condition of learning (maternal overprotection or rejection) on the behavior potentialities (insecurity reactions) of the child.

Frustration

The problem of frustration was given its most complete systematic analysis in *Frustration and Aggression* (11). Frustration was defined as an interference with goal-directed behavior, and the hypothesis was presented that aggressive behavior was a reaction to frustration. In follow-

ing thru the various implications of this notion, the authors suggested a wide variety of quantitative relationships between frustration (as an antecedent condition) and the reactions, mainly aggression, which were consequences of it. These quantitative principles had little empirical evidence to support them, but they had undoubtedly significant implications for a systematic conception of personality development if they were true.

An unusually complete and carefully controlled experimental study has now been published by Finch (13), in which many of these relations were tested on young chimpanzees. The results confirmed to a high degree the principles which had been stated earlier. Finch established several kinds of frustrating situations for the young animals and measured the various signs of emotional disturbance that ensued. His data supported the following generalizations:

1. *The frequency (i. e., strength) of frustration reactions increased with an increase in strength of motivation to the frustrated activity.* Finch used hunger motivation and varied its strength in five different ways: by varying the period of food deprivation, by using different sized food incentives, by using incentives known to have different degrees of attractiveness for the animals, by removing different proportions of food for which the animal was striving, and by substituting either an inferior food or no food at all. Additional evidence for this principle was obtained by Marquis (20) in a study of newborn bottle-fed infants. She measured the quickness of crying and the amount of gross bodily activity following withdrawal of the nipple at different points in the feeding process. She found that the less the amount of milk that had been taken when withdrawal occurred, the hungrier the babies were, the quicker they cried, and the greater amount of diffuse bodily activity.

2. *The frequency of frustration reactions increased with the number of frustrations which had occurred but to which there was no frustration reaction.* Frustrations are summative in their effect.

3. *The frequency of frustration reactions increased with increased conflict.* If two incompatible reactions are instigated simultaneously, the strength of the conflict is a function of how nearly equal the two reactions are in strength; the more nearly equal they are, the greater the conflict.

4. *The frequency of frustration reactions increased with the difficulty of a problem.* The more difficult a problem is, the longer the delay in solving it, and hence the greater is the frustration. This principle has also been confirmed in an experiment on elementary-school children by Zander (37), who observed the children's reactions as they attempted to solve more and more difficult feats of memory for digit series.

5. *The strength of instigation to frustration reactions was less after the reactions had occurred.* This is essentially a statement of Freud's principle of catharsis. It supports the contention in *Frustration and Aggression* that frustration reactions are goal or consummatory responses with characteristics similar to those of other motivated actions.

A number of other quantitative principles concerning the relation of frustration to its consequent responses remain to be investigated.

Altho it is evident that the interruption of eating is a frustration, many action systems of children are so complex and their motivations so obscure that it is often difficult to know what actions by others, or what conditions in the environment, will actually frustrate them. No list of motives yet devised is sufficiently detailed to indicate all the possible ways in which interference may operate. Two studies have demonstrated this with unusual clarity.

Burton (4) created a frustration by satiating preschool children at a peg-board task. Each child was taken, alone, to a room in which was a large empty peg-board; he was instructed to fill it with pegs while the experimenter was busy elsewhere. The child was observed thru a one-way screen, and when he was thoroly satiated with the task, as judged by his tangential behavior, a second child was introduced as a helper. In each instance the satiated child became aggressive toward the helper. Burton aptly interpreted the dynamics of this reaction as involving, for the first child, too much anticipation of punishment from the experimenter to permit of stopping the peg-board task when its intrinsic interest (that is, motivation to perform it) had reached zero. This forced continuation of the performance interfered with the motive to escape from the situation. Aggression was thereafter expressed toward the only available person, the helper. This represented displacement. Under these circumstances, therefore, satiation may lead to frustration.

In a study of two groups of preschool children, one of which was being intentionally taught with rather rigid, suppressive technics, Frederiksen (15) found that overt aggression did not increase. Submissive negativism (crying, noncooperation, etc.) did, however. By analysis of the stimulus conditions it was possible to show that the exact nature of the aggressive behavior depended not on the sheer fact of frustration, but on the associated conditions. These involved greater social suppression by the teacher and, consequently, greater anticipation of punishment in the form of disapproval for expressing aggression. The compromise automatically worked out by the children was an indirect and submissive form of aggression. Both these studies demonstrate the necessity for careful analysis of the exact motives, and the sources of facilitatory and inhibitory stimulation, when frustrated behavior is studied with human children.

A further point of significance in this connection is that of the role of expectancy, or anticipation, in the frustrated motive. Altho Marquis (20) demonstrated that newborn infants show typical frustration reactions to interference with their eating—a kind of behavior which is at first purely reflex and appears to involve no anticipation—two other experiments have shown that expectancy is an important variable with older children, both chimpanzee and human. Finch (13) found, for example, that the frequency of frustration reactions was greater when the frustrated action systems had led more consistently to rewards; when the

young animal had the greatest expectancy of success in getting food, he showed the greatest number of disturbed reactions to interference. Zander (37) was led to the same conclusion in his study of difficult learning problems. His subjects had three days of experience with the task and learned to discriminate between easy and hard problems. Frustration on the easy ones (highest expectancy of success) caused the strongest frustration reaction.

These findings suggest a motivational principle not previously stated: that the strength of a motivated action varies positively with the degree of anticipated success in securing a relevant reward. The corollary demonstrated by both Finch and Zander was that the strength of frustration reactions varies positively with the degree of anticipated success.

Reactions to Frustration

An important problem that has recently received much attention is that of what kinds of reactions occur to frustration. The earlier emphasis on aggression has stimulated a number of investigators to look for other characteristic responses and to search for the factors that induce a child to use one method rather than another. As Sears (26) has shown on theoretical grounds, virtually any kind of behavior which eliminates the source of frustration can become a stable frustration reaction.

Among the behaviors that have been isolated, and that can therefore be added to a list headed by *aggression*, are several which have as their apparent purpose the increasing of cooperative behavior on the part of other (frustrating) persons. These *solicitative* methods vary from crying, whining, and supplicating (4, 13, 15) in younger children to more reserved and dignified requests for assistance in older ones (13, 29).

Various types of *avoidance* or withdrawing were observed in both preschool (4, 15) and older children (37). These included running away from the experimenter or teacher, inattention to the task, hiding, and non-cooperation. All these, no doubt, contained an element of aggression, but to describe them merely as different forms of aggression leaves much to be desired.

Another type of avoidance response, one which seemed to have little reference to the social milieu, was *decontextualization*. In an experiment on the effects of induced failure on adolescent boys, Sears (27) found a pronounced tendency for them to avoid looking at objects, therefore their own performance records, that would reactivate the feelings of failure. This process extended even to their own habit systems, and they avoided saying things (e. g., stating a level of aspiration) which would provide the necessary conditions for frustration. In general, the boys attempted to isolate themselves as much as possible from the context of the frustrating experience.

Quite aside from these psychological reactions, Sherman and Jost (29) found severe signs of physiological disturbance as a result of frustrations caused by the same technic used by Zander (37). These signs in-

cluded all those commonly associated with emotion: changes in electrical conduction of the skin, muscle tension, frequency and regularity of respiration, and the electroencephalogram. A comparison of normal and neurotic children showed the latter to be more upset by the experimental frustration.

Altho it is easy to see how some of the nonaggressive reactions are reinforced by their success in overcoming the frustration, it is not clear what the developmental process is which originates and maintains aggression itself. Some light has been shed on this in a series of measurements by Appel (1). She analyzed the aggressive behavior of free-playing nursery-school children, observing not only the form of aggressive behavior but also the goals the children were trying to secure with the aggression. Only 27 percent of the aggressions were sheer teasing or unprovoked attacks; in other words, 73 percent of the aggressions were adaptive efforts to secure an observable goal. To the extent that these succeeded, they reinforced the use of aggression as a technic and provided for the continuation of "frustration-induced instigation to aggression" as a secondary, or learned, drive.

All the investigations cited have emphasized repeatedly the marked individual differences in the kinds of frustration reactions that young children perform. In the light of Marquis' finding (20) that there are great differences even among newborn babies, it is probable that some of this variation can be accounted for on the basis of constitutional differences in strength and periodicity of drives and the methods of securing gratification for them. With increasing age, however, differences in social milieu (15), nature of secondary drives (1), and the excitatory and inhibitory factors of the immediate frustrating situation (4, 13, 15, 27) appear to increase the number of factors producing variability.

Personality Retraining

The changes in behavior that have been isolated by the majority of personality experiments on children have been of a relatively temporary nature. A strict accounting should show some enduring effects, however, if the principles of learning applied by Whiting (36) and others are valid. Only one major attempt has been made to investigate the possibility of changing children's characteristic modes of social action by experimental means.

In a study of dominative and cooperative forms of assertive behavior in preschool children, Chittenden (8) used a doll-play technic for modifying assertiveness. From a preschool population of seventy-one children she selected the nineteen who were most dominative and least cooperative in their free play and in test situations. Half of these were given extensive training in principles of social interaction by means of doll play in which social conflicts were worked out on a cooperative basis. Comparison of the experimental with the control group a month after termination of the training showed that the dominative aspects of the youngsters' assertive

behaviors had been definitely reduced; evidence for an increase in cooperative assertiveness was less strong.

It remains to be seen whether such changes can prove permanent and to what extent modifications occurring in the preschool setting can overcome antagonistic learning experiences in the home.

Methodology

Three methodological developments are worth special note. In her review for the previous cycle, Murphy (23) pointed out the necessity for utilizing projective technic to discover and measure un verbalized or unconscious motives in young children. The publication of a series of reports by the Sarah Lawrence and Vassar group (19) revealed the details of these technics. Among the methods described were doll play with miniature life toys, plastic modeling, a balloon destruction procedure, and marionette play. The authors gave a rich collection of examples of the use to which these methods can be put for the measurement of young children's personality trends. The methods were not standardized, however, and without this step would remain tools for the use of artists in psychological analysis.

A preliminary step toward objectification and standardization of the doll play with miniature life toys was taken by Bach (3) in a study of the fantasies of thirty-five normal preschool children. Bach used a preschool stylized doll with a teacher doll and several preschool children dolls. The method of presentation of the materials, the procedure of handling experimenter-child interaction, and the categorization of the subject's behavior were all carefully standardized. By so doing, Bach acknowledged, certain subtleties in the child's expression failed to be recorded and properly integrated in the final summing up of the personality trends. From a methodological standpoint this is of little significance, however; the important fact revealed by the research was that it is possible to secure most of the advantages of a free projective technic and yet have the data comparable from one child to another. This procedure opens the way for an extensive experimental attack on the development of motivational systems that have not hitherto been susceptible to controlled objective study.

A second methodological development was the construction of more adequate home-rating scales. Emphasis has already been given to the importance of the measurement of those environmental factors that represent the conditions of learning. The home is the earliest and, for personality development, the most important of these. Champney (6, 7) devised a series of scales based on a careful analysis of what factors in the home could influence the child. By an ingenious use of "cues" he was able to specify the points on the scales so that reliability between home observers was considerably increased.

The third contribution was that of Sanford and his collaborators (25). Their mountainous report presented the data of an intensive three-year study of forty-five children. The professed aim of the investigation was to

secure all the data possible relating to physique, personality, and scholarship. Each child was looked upon as "a whole child."

The methodology represented, that of measuring intensively the existing characteristics of a group of children in order to discover the interrelations among the variables, proved laborious and of doubtful value. Altho the small number of cases in any one age or sex category was partly responsible for vitiating the data, the method itself was not demonstrated to be especially useful. The vast variety of differences in the experiences of any group of children suggests that the experimental variation of small numbers of variables would be more profitable than efforts to measure all possible variables. The problem of multiple determinants of human behavior has not yet been solved.

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CHAPTER II

Motor Development from Birth to Maturity

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IN GENERAL, the emphasis during the last three years seems to have shifted toward the setting up and application of scales for measuring manual and mechanical abilities, on the one hand, and bodily coordination or physical fitness, on the other.

Neuromuscular Development in Infants

There are several new publications on the studies of McGraw and her associates in the Normal Child Development Study of Columbia University. The earlier reports have been restated and summarized by McGraw (41) with her interpretation of their theoretical implications and practical value. Further reports from these studies have been concerned with technics for measurement and treating the data; McGraw and Breeze (42) described a technic for measuring erect locomotion from motion pictures. Campbell and Weech (6) presented a method of appraising a child's performance in terms of status at birth and rate of change. They found that individuals are poorly differentiated from the group before three months of age, and only after this age would it become possible to make accurate assessments of individual attainment. McGraw has prepared an additional motion picture film, "Reaching-prehensile Behavior in the Human Infant" (40).

From the Yale laboratories came a study by Gesell and Halverson (22) based on daily motion pictures of one infant from the 15th to the 235th day of life, taken in a standard situation. Responses to an embroidery hoop (moving and stationary) indicate that the behavior changes are continuous, showing gradual maturing of cortical control of the neuromuscular system.

Age Changes and Sex Differences in Childhood

In a comparison of nine-year-olds with adults, Davis (14) has found that motor responses do not become localized to the primary responding area, as in adults, until sometime after nine years of age. Davis compared action potentials (galvanic electrical currents) of nine-year-olds with those of adults, when the relaxed subject lifted a weight with his left hand at a signal.

Age changes and sex comparisons in strength and in various motor skills have been reported in a number of studies. Metheny (44) has summarized the literature on strength of grip for preschool and elementary-school children. Recent studies on private-school children, using a Smedley type dynamometer, reported higher averages than did earlier studies. Grip

strength for boys and girls increased 65 percent from three to six years. Boys showed an increase of 359 percent from six to eighteen, whereas girls improved 260 percent. Boys excelled at all ages.

Vickers, Poyntz, and Baum (61), who adapted the Brace test of motor ability for use with children ages five to nine, reported no consistent sex differences in this age group. Average scores increased with age, but there was a wide spread of scores at all ages. In an investigation of the validity of the hurdle jump as a measure of motor proficiency of children four, five, and six years of age, Hartman (26) gave five tests: jump-and-reach, standing broad jump, baseball distance throw, 35-yard dash, and the hurdle jump. No significant sex differences were found in any of the tests used except the baseball throw for distance. In this event the older boys were superior.

A study from South Africa by De Jongh, Cluver, and Jokl (15, 36) is of great interest because of the large number of children tested and the use of the same tests at all ages. Physical efficiency tests, 27,654 in all, were given to children aged six to eighteen years. The three tests given all children were selected to represent three types of ability: the 100-yard run tested "basic skill"; the 600-yard run tested "endurance"; and throwing a 12-pound shot tested "strength." All three performances showed increases until puberty, where there was a very evident break in improvement for all tests for both sexes. After puberty the boys improved in all tests; strength continued undiminished, while the other two improved more slowly. The girls' curves were very different after puberty. Strength increased at a somewhat diminished rate, but "basic skill" plateaued, showing little change, while "endurance" scores regressed and became successively poorer. Older children, especially girls, took much longer to recover from the 600-yard run than did the younger children.

Measurement of Motor Abilities

Tests of strength and of general motor ability and capacity have been adapted by Carpenter (9, 10) for children in the first three grades. Norms for the tests are given in the articles. The Brace test was modified slightly by Vickers, Poyntz, and Baum (61), and a scoring scale to be used with preschool children was devised. Hartman (26) found the hurdle jump no better as a measure of motor proficiency in children than any one other test given. This test yields correlations of the order of .5 percent with other tests of jumping, throwing, and running. Taylor (56) published achievement scales in seven physical education skills for children in the first three grades. DeJongh, Cluver, and Jokl (15) developed a grid on which children's percentile scores in the South-African physical performance tests could be readily determined.

Bookwalter (3), Gloss (24), and Stansbury (55) conducted extensive studies on the physical performances of high-school boys. Each author has presented a short battery of tests to be used in selecting homogeneous groups of boys for activities. Bookwalter and Bookwalter (4), from a

set of twenty tests, selected three representative tests which could be easily given. An index based on "chins, push-ups and vertical jumps" was found to be valid and useful educationally. In another publication (2), norms are given for several indexes based on different combinations of items which can be used, depending on the availability of material. In a report of the Andover Physical Fitness Testing Program, Johnson and others (35) presented a simplified classification scheme for boys' and girls' norms for events included in a battery of motor fitness tests. Ehrlich (19) showed that the City College physical proficiency test was a highly reliable and valid instrument for use with college men. Heath (30) reported on the military use of a rail-walking test as an index of locomotor coordination. The test is useful as a gross instrument in diagnosing awkwardness and in predicting trainability, but does not differentiate well at the upper levels. Two recent studies (18, 28) of the sit-up test indicate that this test as now given is not a good measure of abdominal strength. Havlicek (28) proposed giving the test for time and gave norms for time.

Norms of tests for high-school girls of general bodily coordination, strength of arm and shoulder girdle, abdominal strength and endurance, have been published by the research committee of the national section on women's athletics (43, 60) of the American Association for Health, Physical Education, and Recreation. Hatlestad (27) gave comparable scores for a number of tests of motor educability for women. Scott (52) suggested a revision of previously published batteries of motor ability tests for college women and included T-scores for all tests in the batteries.

Relation of Motor Abilities to Other Factors

There appears to be some disagreement concerning the relationship of motor to intellectual abilities, and to personality characteristics. Milne and others (45) found no correlation between intelligence test scores and scores on the three South-African motor tests for 202 girls aged eleven to seventeen years. On the other hand, according to Vickers, Poyntz, and Baum (61), motor ability in preschool children was positively related to high intelligence (and also to good abdominal muscles, and inversely related to obesity). Siblings and twins were more similar in performance than unrelated children. A relationship between mental and motor abilities among feeble-minded was reported by Heath (29) who found rail-walking performance to be definitely related to M.A. among feeble-minded boys whose mental status was endogenous (inherent); however, there was no relation between scores and M.A.'s of boys whose feeble-mindedness was of exogenous etiology. Physical skill as measured by the Johnson test was unrelated both to scores on the American Council on Education test and to academic grades of college students (33). Reliable differences between varsity and intramural groups as distinguished from nonathletes were found by Sperling (54) in personality adjustment, attitudes, interests, and motivation.

The motor fitness of farm boys was studied by Hall and Wittenborn (25) at 4-H Club camps. He found dynamic strength unrelated to diseases of childhood. He concluded that 4-H boys have a robust body build, organic health capable of sustained effort, and motor fitness. Older boys are superior to younger ones.

Relation of age at walking to physical maturity and other factors were studied by Dennis (16, 17). A survey of the literature on *pubertas praecox* disclosed that these cases, in spite of great advancement in strength and bone development, showed no deviation from the normal in age at walking. Jokl and Cluver (36) reported a number of athletes who have had serious physical deficiencies but have compensated for them and made outstanding records. Peatman and Higgins (51) found no relation between body build and age at sitting, standing, and walking alone in a group of 349 healthy infants. Weech and Campbell (62), however, found that when *rates of growth* are studied, the "infant who is expanding rapidly in physical size develops . . . more slowly in behavior than does the infant with a slow rate of gain."

Kopp (38) gave the Oseretzky Scale of Motor Performance to 450 stutterers and found their motor scores consistently retarded. She gave case studies but no statistics on the group as a whole. She concluded that stuttering is a symptom of a much more general disturbance of motor function.

Race Differences

Spanish-American boys were reliably superior to Anglo-Americans in running, jumping, throwing, and chinning altho no significant differences in height and weight were found, in tests made by Thompson (58) and Thompson and Dove (59). Moore (46) tested speed of reaction of Negro and white preschool children on an eye-hand coordination test. The differences were not statistically significant. Cluver, De Jongh, and Jokl (11) compared five racial groups, "European, Bantu, Coloured, Indian and Chinese," on the 100-yard run, 600-yard run, and shot-put and found only slight racial differences. On the average, the Bantu made the best scores; then came in order, Europeans, Coloureds, Indians, and Chinese. The puberal loss in efficiency occurred earliest in the Chinese and Indians and latest in the Europeans and Bantu. There were other indications of racial differences in the forms of the age curves.

Influences of Environment and Training

The effects of practice and training appear to differ with the nature of the tasks involved and the factors with which they are compared.

Dennis (17) found that tho special training and good health did not advance age at first walking, certain deprivations, such as recent illness and lack of opportunity to practice, operated to retard walking. Jokl and Cluver (36) found that young men who were in very poor physical condition improved their scores in motor tests after a six-month regimen

which improved their health and general physical fitness. Owens (48, 49) gave fifteen junior high-school boys seven of the Minnesota Mechanical Ability tests eight times. He found that repetition of the tests did not change their variability, but individual differences remained constant or even increased with practice. Hilgard and Smith (31) gave college students practice on the pursuit rotor. Those with fewer trials and longer rest periods did as well as those with more trials but shorter rest periods. Woodward (64) found transfer of training occurred when trade-school girls assembled objects which employed different materials but the same general pattern of motions.

Moore (47), investigating the hypothesis that race differences might be cultural, tested preschool children to avoid prolonged influences of cultural factors. Negro and white children were given an eye-hand coordination test and the Van Alstyne vocabulary test. The two groups were very similar in the motor test, but the whites were superior, especially at the older ages, on the vocabulary. The relationship of several tests of motor performance to the learning of specific motor skills was studied by Ehrlich (20) and by Gire and Espenschade (23). Neither study found any significant correlation between any test and learning.

Improvement of college women in general bodily coordination in a three-month period was reported by Espenschade (21). Girls who scored low at the first testing did not improve more on the average than did girls whose initial score was high. Thompson (57) gave tests of manual dexterity to dental and fine arts students and found them to make scores superior to general college students. Furthermore, among dental students the seniors were superior to the freshmen in motor and mechanical skills.

Several investigators have reported on the improvement in physical fitness of college students participating in conditioning programs for the Army or Navy. Hughes (32) and Wendler (63) reported below-average scores for groups before training. Students in a special "Fitness Clinic" improved approximately 34 percent while those not given special attention improved only 7 percent according to Cureton (12). Daubert (13) commented upon the strong motivation for such groups after Pearl Harbor and attributed higher first-test scores to this. Bookwalter (1) found gains after five months of training: In strength 25 per cent; in motor fitness 19 percent; in velocity 7 percent; and in endurance 3 percent. Kistler (37) also found significant improvement after an eight-week training period in endurance, strength, and agility but reported that an appreciable percentage of the men retrogressed. Johnson (34) reported significant improvement from first to last test scores of the semester in ten events selected to measure endurance, power, strength, ability, flexibility, and balance.

Nature of Motor Abilities

Recent studies on the nature of motor abilities have in most instances taken the form of factor analysis, or of intercorrelations which reveal the degree of specificity of scores.

Larson (39) carried out factor analyses of the results of two batteries of motor tests given to college men. He found six fundamental elements underlying performances: (a) dynamic strength, (b) gross bodily coordination and ability, (c) static dynamometrical strength, (d) motor explosiveness, (e) motor educability, and (f) abdominal strength. Carpenter (7) gave a short battery of tests to college women and identified three factors: (a) strength, (b) velocity, and (c) dead weight. The same author (8) studied the Johnson test in an effort to isolate measures of true motor educability. Five of the ten test items seem to contribute to this factor, altho the major contribution is made by two tests, a "forward skip" and a "jumping half turn."

Seashore (53) studied the relationships of gross and fine motor abilities. A factor analysis yielded three factors: fine motor abilities, dynamic gross motor abilities, and postural steadiness. He found no evidence of any interdependency between gross and fine abilities.

Owens (50), using the analysis of variance on the mechanical ability tests which he gave to fifteen junior high-school boys, found that "the tests are as discrete as the individuals." Thompson (57) reported "semi-specificity" in manual skills of college students.

In general, the evidence points to low relationships between specific motor abilities, tho there is some factorial evidence that performances involving similar functions are at least partially interdependent.

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CHAPTER III

Mental Maturity from Birth to Preadolescence

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DURING THE PAST FEW YEARS there has been an increasing recognition that mental growth is a product of integrated development. The emphasis has been of late, perhaps, upon those factors relating to social and personal development, but a considerable amount of work continues with respect to that phase of development termed mental.

Several reviews and summaries of research have appeared recently. Under the editorship of Barker, Kounin, and Wright (5), thirty-five investigators have summarized their researches in the field of child behavior and development. In each instance the author, who was chosen on the recommendation of many workers in these areas, has presented the significant data and conclusions of his own researches. Each study is accompanied by a bibliography. The work constitutes a valuable reference for students and research workers. The first seventeen of these studies are particularly in the area of this review. Loevinger (50) has evaluated fully and carefully the evidence on the proportional contributions of nature and nurture to intelligence, including the studies of twins by Burks (13) and Woodworth's survey (77) of literature on twins and foster children. Together, these constitute an exhaustive account of present knowledge on this much disputed problem. It is clear, however, that the last word is still to be said and the authors suggested further methods of attack.

Pintner and Forlano (60) have examined several studies of season of birth and mental differences and conclude that this is only one aspect of seasonal fluctuations of numerous physical, mental, and sociological factors, altho Mills (56) in a later report found that the likelihood of college matriculation rose "high above the normal expectancy" for those individuals conceived during the winter months and was low for those conceived in summer months.

The results of several years of the Harvard Growth Studies are summed up by Dearborn and Rothney (18). In a review of the effect of war on children, Jersild and Meigs (37) showed that children even six or seven years of age have a considerable store of information concerning the belligerents, military campaigns, and so on; and Dennis (19), from a critical study of the evidence, concluded that behavior of the infant at birth is mostly unlearned, fetal development being almost entirely maturational.

A review of the literature on childhood memories has been made by Dudycha and Dudycha (22), who themselves have contributed to such researches and who suggested problems and cautions needed in further investigations. The age of earliest "permanent" memories, the relation of mental age to ability to retain early experiences, and similar questions, appear still to be matters of doubt.

Tests of Infants and Young Children

Altho Irwin (33) doubts if infants can have IQ's because they lack development of the cortex and have not attained an upright position nor coordination of vocal cords, tongue, and lungs, there are still attempts to estimate the mental development of children in the early periods of life and to validate these estimates. Shotwell and Gilliland (65) have presented a new scale for measuring the mentality of infants of four weeks, eight weeks, and twelve weeks. In this an attempt is made to select measures of adaptability rather than of physical structure or reflexes. On the other hand, longitudinal data on development of sitting, creeping, walking, reaching for a lure, and reaction to pin prick reported by Campbell and Weeck (15) suggest that scales based on achievement in behavior are unreliable under three months of age.

On the matter of procedure, McGraw (52) has pointed out difficulties in appraising the responses of infants and young children. Both oral responses and motion pictures were used to illustrate the need for objectifying the experimenter's interpretations, and Ames and Ilg (4) insisted that the variant behavior on a developmental examination is an integral and significant part of the whole response. The average child exhibits variant behavior instead of other, while the superior child exhibits it in addition to other.

Ackerman (1) found, thru a statistical study of scores and a study of separate items, that the Viennese tests are valid instruments for infants from six to twelve months old. The short form of the Stanford-Binet scales appeared from a study by Brown (10) valid for use at the kindergarten level, and Ames (3) showed that the Gesell Incomplete Man test differentiates between children of IQ's 90 to 110 and those of IQ's 120 and above.

Bowley (9) has devised a record form to estimate the general development of children during preschool ages. A separate profile is kept for each child. Average children tend to be more advanced in language development than either oldest or youngest children.

Smith (68) has developed a test of general information for children of two to five years which, tho not called a test of mental ability, probably measures much that such tests measure; and Kent (42) described the Andover School Entrance test, consisting of twenty-five orally presented questions, the purpose of which is to divide children into groups with respect to probable achievement rather than to provide individual ratings.

Stability of the IQ and Environmental Effects

Altho during the period covered by this review, there was much discussion of the stability of the IQ and of the effects of different environments on mental development, there was not very much in the way of new research. Some of it, however, is important. Goddard (25) has reviewed the Kallikak study, answering those who have criticized it and pointing out the thoroughness with which this early study was done.

Notwithstanding the low correlations between tests in infancy and those given later, Lauvetz (45) found that among a group of infants tested under two years of age and retested after reaching at least the third birthday, those receiving very low or very high ratings in infancy received distinctly lower or higher than average scores, respectively, on the later retest.

In an especially well-controlled investigation, McHugh (53) tested and retested almost the entire kindergarten population of a small New Jersey town. The average age was 62.02 months and retests were made after thirty three-hour kindergarten sessions, an average time interval of 1.93 months. Significant gains were made on the Stanford-Binet 1937 scale. These gains are attributed primarily to developmental adjustment, especially in speech. A critical discussion of the problem is included in the monograph.

Rhinehart (62) also found evidence of positive values in the nursery-school experience of forty-two children from the lower middle class of Cleveland, Ohio. The half which attended nursery school at the beginning rated 7 IQ points below those who did not attend such a school and on a test at the end of the school averaged 2 IQ points higher.

Worbois (78) found some evidence of gain in IQ, not due to differences in home environment, among children changing from a one-room school to a consolidated school, but no gain and perhaps a loss when the change is from a consolidated school to a one-room school. Shaw (64) reported a correlation of .39 between scores on Sims score cards and Stanford Achievement EQ's.

Further evidence of environmental influences is indicated by Rheingold (61) who reported that babies who had been "only" children in boarding homes showed higher development with Gesell schedule than did those who had shared the home with others.

An especially interesting study is that of Wheeler (74) who examined a large number of east Tennessee mountain children in 1940 making possible a comparison with children in the same area in 1930. Ninety-one percent of the families have been life-long residents of this region, but during the decade there has been marked improvement in economic, educational, and social conditions. As compared with the 1930 group the children in 1940 were eight months younger chronologically for their grades and nine months older mentally. There was still a decrease of about 2 IQ points each year from ages six to sixteen which the author attributes to age-grade retardation.

Closely related to the effect of the environment on intelligence is its effect on language development. Worbois (79) has shown that the language development of children in one-room schools is inferior to that of those in consolidated schools. This tends to confirm the hypothesis of McHugh.

The language of six children of the Purdue Nursery School was observed by Williams and Mattson (75) under various conditions. Of the social group investigated, the combination of two children and an adult resulted in more talking, more words per sentence, and more friendly in-

tercourse. Small social groups were recommended as most favorable for the language development of three-and-one-half-year-olds. It is undoubtedly implied that the adult in these groups should be experienced in talking with children.

In companion studies, Young (80, 81) reported the observation of children thirty to sixty-five months of age in the nursery school of the University of Georgia. There seem to be differences among socio-economic levels in the use of exclamatory words and there is a progressive change in the frequency in the use of possessive pronouns—the reference to self decreases as that to others increases.

Skeels (66) presented further evidence from the Iowa studies to the effect that children from mothers of low intelligence or from fathers of low occupational status, or both, show no more mental retardation than is to be expected from the general population.

As a part of the longitudinal study of the Brush Foundation, Katz (41) studied 208 children under school age, mostly drawn from a high socio-economic level, using the 1916 Stanford-Binet. Retests made from three-month to twelve-month intervals over one to three years resulted in variations of 20 or more IQ points in 40 percent of the cases. Again, Allan and Young (2) tested and retested 130 children. The mean initial age was four years and retests at intervals of one to twelve years, with an average age of final test of nine years five months. The same instruments were not always used for test and retest. The authors found that constancy of IQ varies with the criterion of constancy. It is influenced by such factors as interval between tests, type of test, sex, intelligence, and age.

Goodenough and Maurer (26) studied the predictive value of the Minnesota preschool test. In this twelve-year study comparisons were made between first tests on the Minnesota scale and later tests with the same instrument, or with various ones of other tests. In general, the predictive values of tests given before age three are not high. The nonverbal portion of the Minnesota scale in many instances correlated more highly than the verbal scale with late scores. There is a suggestion that specialization of abilities may be detected earlier than has been supposed and that the rate of mental stabilization of girls, especially before age three, is greater than that of boys.

That the tendency for IQ's to drop with advancing age is a function of the method of expressing test results rather than a function of the test used is demonstrated by Kuhlmann and Odoroff (44) and the superiority of the Heinis Personal Constant, now called "Percent of Average," for at least a part of the growth curve is claimed.

Siblings

Thorndike (70) concluded, thru correlations computed by himself and from the results of others, that the true sibling resemblance is .70 or

higher rather than .50 or below as has usually been reported. Gesell and Thompson (24) have brought together their observations from infancy to adolescence on twins T and C. This is a significant contribution from the viewpoint both of the data themselves and the technic employed of co-twin control. The outstanding findings are (a) that the special opportunities given twin T resulted in no substantial addition to her original equipment and (b) that pure psychogenetic factors to explain individual differences are difficult to find.

Physical Correlates of Mental Development

As one result of an attempt to verify his hypothesis that walking is a result of multiple conditions each of which must be present before the ability develops, Dennis (20) found, contrary to general opinion and some researchers, that gifted children walk no earlier than do those of normal ability. Boas (7), however, indicated that among children in the Lincoln School (Columbia) those who are advanced for their age physically are advanced mentally. Knott, Friedman, and Bardslay (43) made electroencephalograms of eight-year-old and twelve-year-old children representing a wide range of intelligence levels. Among the eight-year-olds, but not among the twelve-year-olds, some relationship was found between Alpha frequency and intelligence.

A few studies illustrate the wide range of attack on problems of induced physical effects on ability or learning. For example, Murphy, Shirlock, and Doll (57) reported a case of microcephaly following maternal pelvic irradiation for the interruption of pregnancy and referred to earlier studies. In keeping with the current emphasis on vitamins, Harrell (27) gave thiamin to one group, ages two to twenty, carefully matched with another group as to age, sex, intelligence, and weight in relation to expected weight. The thiamin-fed group excelled the controls in many functions, including the learning of school subjects.

These considerations reinforce the general point of view that any study of the development of the child must consider the child as a whole. Olson and Hughes (58) illustrated their concept of organismic age by data from a seven-year-old boy and Mechem (55) carried the concept still further in a study of effectivity in pupils. Only slight relationship was found between mental age and affectivity, but those whose affectivity scores gained most between interviews tended to gain more in mental age.

Biographical Studies

Biographical data are, of course, subject to many limitations, but the account of the early development of Leta Stetter Hollingworth, as given in the biography prepared by her husband (29), is not only a study of the development of a genius but is a vivid description of many factors which influence the child mind. Theman and Witty (69) have given us the records of two gifted Negroes which also show the effect of attitude and motivation on achievement.

Two important studies in detail of the behavior and activities of children at particular ages have been presented by Woodcock (76) and by Biber and others (6). These give pictures from daily records of the physical growth, social development, mental activities, and the like, of children two to three years and seven years of age respectively. The children were highly selected and much of the observation is anecdotal, but the studies furnished much valuable information.

Special Abilities and Disabilities

The biography of Leta Stetter Hollingworth, mentioned above, is the account of a gifted person. Her study of children above 180 IQ (30), published posthumously by her husband, is a valuable contribution to the understanding of such persons. It includes a critical review of the concept of giftedness as well as the long-time study of twelve very gifted children, who it is noticed maintained their high differentiation from the normal group. Johnson (38) has aided in the understanding of one of the common problems of the gifted by showing that the negative relationship commonly found between intelligence and achievement among the gifted is probably not because they are not living up to their ability but because they are becoming more specialized. Lewis (46) confirmed other research to the effect that children with IQ's above 144 have more extensive interests, are more stable, and yet are more adventuresome than are those with IQ's of from 125-144.

Various studies of defective children have also appeared. Doll (21) gave evidence that among morons social age is better for classification than is mental age. Horne and Philleo (32), comparing spontaneous play activities, found more differences between normal and mentally defective children than among two groups of mentally defective. Werner (72) tested one hundred mentally retarded, grouped at four mental age levels on the marbleboard. The continuity-type of performance predominated at all ages, but declined relatively with mental growth being increasingly replaced by the constructive type of performance. An experiment in cottage training of children of CA's seven to twenty-two, but with IQ's of 36 or under, resulted in little success in engendering habits of bodily care, altho the training is recommended as there is some hope of improvement in some cases (17).

A few investigations have been made on children suffering from special handicaps. Burchard and Myklebust (12) found deaf children in the New Jersey School for the Deaf to be of average intelligence and found no significant differences between those congenitally deaf and those who have become deaf, no differences between the sexes, and no differences between those in the institutions more and less than four years.

Hildreth (28) tested fifteen partially seeing children aged seven to fourteen years, using the Stanford-Binet as adapted by Pintner. All but one had some other defect also and apparently progress in school was affected by a combination of factors and not visual defect alone.

In a detailed account Werner and Carrison (73) exhibited many differences in thinking between normal and brain-injured children. Especially is there a higher degree of animistic thinking in the brain-injured which cannot be explained with reference to a general retardation in verbal concepts.

Seasonal Variations in IQ

Seasonal variations in IQ were examined by Jones (40) who, using nursery-school records, found that IQ gains consistently, if not reliably, from fall to spring. That this is not due to nursery-school training, as such, appears from the fact that similar gains were not made by those attending summer-session nursery schools, and that the changes continued among nursery-school cases even tho they did not continue in nursery school. Further studies by Jones of nonnursery-school cases tend to confirm the fall to spring gain as compared with spring to fall.

Mental Development in Infancy

Marquis (54) has shown that learning takes place in the neonate. Three groups of infants under eight days of age on different feeding schedules showed varying amounts of activity which was affected markedly by changes in the schedule. A shift from a three-hour to a four-hour schedule was accompanied by increased activity and "upset" conditions.

Irwin and Chen (36) have shown that the speech sounds of the newly born can be observed quite reliably, and Irwin (35) has shown that the developmental status of speech sounds of a group of four-year-old feeble-minded children is less than that of normal children less than one year of age.

In an attempt to study the complete history of certain developmental factors, Ling (50) sought to find the nature, occurrence, and development of sustained visual fixation in infants varying in age from seven minutes to twenty-four weeks. A sustained visual pattern is not present at birth but appears in a few hours and reaches a peak in four or five weeks. Six stages of development are identified. These are marked and show individual differences. Working with somewhat older children, four to seven years, Long (47) found that altho a subject was able to select the larger of two figures of the same shape, it was much more difficult to select the larger of different shapes. The accuracy of discrimination was about the same for circles, squares, and rectangles.

Long and Welch (49) also studied the ability to discriminate numbers, using marbles in various sized groups. Discriminative ability improves regularly to about five or six years of age. No significant correlation between intelligence and general qualitative ability was found.

Holodnak (31) had sixty-four children, ages six to ten, learn a punch-board maze. For these children, as for adults, learning under positive guidance is superior to that under negative guidance.

Very little good work has been published hitherto on the ability of young children to reason. Long and Welch (49) and Welch and Long (71) have given in companion studies, technics for studying this problem. Reasoning tests of varying types were given to fifteen children between the ages of six and eight with IQ's 85-131 and later to ten four- to six-year-old children with IQ's 100-122. Some ability to generalize was found and differences between the age group were noted.

From the use of the Rorschach test, Rose and Stavrianos (63) discovered that girls tend toward more detailed responses than do boys, have more "human" responses, and react more strongly to both. Boys have more "object" content and are better able to integrate form and color.

In order to measure monotony, the task of drawing "moonfaces" was given by Burton (14) to twenty-three preschool children and to forty college sophomores. Monotony occurs in young children in much the same form and from much the same causes as it does in adults.

Bonney (8) has investigated factors determining pupils' choices of friends. All correlations between intelligence and mutual attraction were positive and those between intelligence and rejection were zero or negative. Intelligence is one factor in determining mutual friendship and intellectual ability does not in itself guarantee social skills.

Racial Differences

As a study particularly of individual differences, Brown (11) compared on Stanford-Binet 1916 scale 324 second-generation Jewish children with 323 second-generation Scandinavian children in Minneapolis public kindergartens. Rigorous controls were exercised. Consistent negative results were obtained with respect to differences in intelligence between the racial groups. Fewer Jewish than Scandinavian children were in the IQ range 80-89. There were some differences between the group on particular items of the test which tended to disappear in passing from lower to higher socio-economic levels.

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CHAPTER IV

Mental Development During the Preadolescent and Adolescent Periods

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THE RESEARCH reviewed in this chapter pertains to a single aspect of human growth and development, the mental aspect, where the term "mental" is interpreted to include general intelligence, thinking, reasoning, concept formation, memory, and language. Studies of the growth and development of mental activities in relation to their physical and social environment, as well as studies of the effect of disease, drugs, and diet on mental growth, are also included. However, only studies involving pre-adolescents or adolescents (approximate age range from eight to twenty years) are reviewed. *In toto* the available literature is characterized by (a) a dearth of comprehensive longitudinal studies; (b) the publication of several excellent summaries of previous research; (c) an emphasis upon the case history technic with character and personality factors receiving prominent consideration; (d) a preponderance of fragmentary and peripheral studies; (e) a tendency to report research findings and their implications in nontechnical language for the benefit of parents and others most intimately concerned with children; and (f) the absence of a definite conceptual framework for coordinate research.

Longitudinal Studies

Most of the recently reported studies of mental growth were exploratory in nature. An exception was Goodenough and Maurer's account (31) of the constancy of mental ratings initially determined for two- and three-year-old children by the Minnesota Preschool scales. A comparable study was completed by Ebert and Simmons (25) who determined the mental growth patterns of children associated with the Brush Foundation. In both studies data were obtained over a period up to twelve years in extent. Both reports either stated or implied that (a) for the groups as a whole there was considerable variation in mental ability rating between the initial score and subsequent scores; (b) the pattern tended to be different for boys and girls, but probably not significantly so; and (c) the numerous individual variations were in large measure due to peculiarities within the individual rather than the result of inadequate test standardization.

Miller (54) found an average positive shift of 11.8 IQ points for fifty-three children, and an average negative shift of 8.5 IQ points for thirty-five children, to whom the Binet had been administered upon entrance to the elementary school and again upon entrance to high school. Allan and

¹ Valuable assistance in the preparation of these materials was furnished by Jane Elizabeth Blair and Emily Powers Coffin.

Young (2) found the constancy of the IQ to be influenced by the length of interval between tests, types of tests used, IQ level, sex, and chronological age. In contrast, Bonney (12) obtained correlations ranging from $+ .71$ to $+ .93$ between IQ ratings separated by an interval of one year. His samples, however, were small. Goldin and Rothschild (30) found correlations of $+ .80$ or higher, for children of Italian parentage, between Henmon-Nelson scores originally obtained in the fourth grade and retests with the same test at the sixth- and eighth-grade levels; but the correlation was only $+ .46$ for Pintner-Cunningham scores obtained in the first grade and Henmon-Nelson scores obtained in the fourth grade.

Hildreth (35) completed her analysis of 149 train and locomotive drawings selected from a continuous series of more than two thousand drawings made by one child between the ages of two and eleven years. A smooth and consistent growth curve, with no sharp breaks or regressions during the nine-year period, was obtained.

Summary statements pertinent to future longitudinal studies were made by Hamalainen (33) on pupil growth in the elementary school, and by Jersild and Fehلمان (40) on developmental objectives.

Summaries of Research

In addition to the "Growth and Development" issue of the REVIEW OF EDUCATIONAL RESEARCH (39, chapters II and III), a number of additional publications containing summaries of mental growth have recently appeared. The National Society for the Study of Education's yearbook on adolescence admirably summarized the currently accepted theories and research in this field.

Brownell's summation (14) of theory, research, and practice pertaining to problem solving indicated that eight years was the minimum age at which children are conscious of the basis of their thinking as well as the need for satisfying others of the validity of their conclusions.

Interpretative accounts of research in mental growth and development are a part of recently published text and reference books. Stoddard (73) reviewed studies pertaining to the meaning of intelligence; Breckenridge and Vincent's bibliography (13) of 806 titles contained many references to mental growth; and the *Encyclopedia of Child Guidance* (84) summarized the implications of research in numerous phases and for various concepts of child growth. Minor surveys were made by Maddy (51); by Mohr (56); by Ryans (65); and by Stansbury (72).

Some Interrelationships with Intelligence

Personality and conduct—Ackerson (1) reported the results of a monumental study in which 125 different human behavior traits and notations were intercorrelated, yielding some 14,000 correlation coefficients. This was a quantitative investigation into the causal factors underlying undesirable behavior manifestations in children. The subjects were 3294 white children (2113 boys and 1181 girls) between the ages of six and

seventeen. These had been examined consecutively at the Illinois Institute for Juvenile Research over a period of years. The IQ range for the total group was from 50 to 150; the boys' distribution had a mean of 83 and a standard deviation of 17; that for the girls yielded a mean of 82 and a standard deviation of 16. Because of its comprehensiveness and large sampling from among children who were behavior problems, Ackerson's study takes on added significance at this time when the problem of juvenile delinquency has been accentuated.

Ackerson found a low, but positive, correlation between IQ and general behavior indexes. For boys $r=.15$ and for girls $r=.16$ when IQ was correlated with "personality total," the unweighted sum of all personality problems reported for an individual child. IQ and "conduct total," the unweighted sum of all conduct problems reported for an individual child, were related to the extent of $r=.13$ for boys and $r=.12$ for girls. The relationship between "police arrest" and IQ was negative, but insignificant; $-.02$ for boys and $-.07$ for girls. Relationships between IQ and a variety of behavior patterns were studied.

Mechem (52) investigated the affectivity (feeling) side of personality by means of a standardized personal interview technic. Her subjects were seventy children in Grades II thru VI in the University of Michigan Elementary School. She found that mental age was not related to affectivity for the group as a whole (r 's of .01 and .09); but that the relationship took on significance when the data were treated separately by grade groups (r 's of about .30). IQ and affectivity, on the other hand, were related to the extent of $r=.25$ for the group as a whole. Thus, chronological age was a constant factor. Mechem also ventured to suggest that children whose all-round development showed acceleration tended to be happier, based upon the fact that the correlation between organismic growth rate and direction of affectivity scores between interviews was .37.

Friendship—Emphasis upon socialization as an important part of education was reflected in Bonney's research (10, 11). For elementary-school children a noticeable, altho not consistent, trend between degrees of friendship and intelligence was found to exist. The median correlation between the IQ's of "very mutual" friends was $+.33$; between "moderately mutual" friends, $+.35$; between "weakly mutual" friends, $+.23$; between "largely unreciprocated" friends, $-.16$; and between "very unreciprocated" friends, $-.03$.

Physical performance—Milne and others (55), working with a South-African population of various racial backgrounds, analyzed the relationship between intelligence and athletic prowess. For 202 girls, ranging in age from eleven to seventeen years, the IQ determined on the basis of the South-African Group Intelligence test was found to have little or no relationship to athletic ability.

School achievement—Ames (3) found a coefficient of correlation of $+.54$ between scores on the Otis Self-Administering test and high-school

marks. This was raised to a multiple R of $+.72$ by including thirteen different personality ratings. However, her three best predictive indexes of high-school marks, Otis scores, and teacher ratings of attitude and of persistence, yielded a multiple correlation of the same magnitude ($R=+.71$). Based on her analysis of fifteen variables related to school achievements in Grades X, XI, and XII, Nelson (57) concluded that "average" intelligence is sufficient for academic success in high school, provided there are no interfering personality or adjustment factors. According to Reynolds (64), high-school leaders, those who hold responsible student offices and who actively participate in numerous extracurriculum activities, tended to excel in both intelligence and scholarship.

Lorge (47) found correlations ranging from $.44$ to $.66$ between mental ability and the highest grade completed in school; and Fahey and Corey (26) concluded that teachers may infer the intelligence of their pupils from the questions asked by the pupils in the classroom.

On the elementary-school level, for drill subjects, intelligence apparently is not as essential to academic success as it is for the more complex high-school subjects. Wheeler (83), working with some three hundred third graders in Tennessee, found a correlation coefficient of only $.18$ between IQ and rate at which multiplication combinations were mastered.

Parental occupation—Differences in IQ's obtained for children from varying socio-economic groups are known to exist at all levels from the nursery school thru the college. Maddy's recent study (51) verified this for 319 children in the sixth grade from fifteen Washington, D. C., public schools. Livesay (45) reported a correlation of $.4$ between the American Council Psychological scores of high-school seniors in Hawaii and their parents' incomes. Lewis (44) noted that an educationally accelerated group had superior home backgrounds. In contrast, Davidson (23) reported negative relationships between the mental ability of a group of bright children (IQ's ranging from 120 to 200) and the economic status of their parents. Her correlation between mental age and parental income was $-.28$; and between IQ and parental income, $-.34$.

Culture—Thorndike and Woodyard (78) obtained the scores on the National Intelligence test for sixth-grade pupils in thirty cities and then compared these mental ratings with various aspects of community life. They found an intercity relationship as follows: a coefficient of correlation of $+.78$ between intelligence and per capita income of parents; an r of $+.86$ between intelligence and a composite civic rating made up of items of education, socio-economic factors, and creature comforts; and an r of $+.82$ between intelligence and a culture index made up of per capita number of homes owned, telephones, and various health items. Kobler (43) made a study of the intelligence of Italian, German, and Jewish children living in separate "community groups" on Chicago's near north side; but he was unable to state significant differences.

Mental Pattern versus Personality and Adjustment Pattern

Pignatelli (61) obtained a "mental functioning pattern" for some three hundred problem children seven, eight, and nine years of age, and also for a comparable group of nonproblem children. Her technic was to analyze their responses on the 1916 Stanford-Binet according to the mental function that is most active during successful performance of the various subtests. She found that mental functions and adjustment were unrelated for children of average mentality. Davidson (23), working with Rorschach data for children whose IQ's ranged between 120 and 200, came to a similar conclusion. However, Davidson's Rorschach protocols were decidedly different from the usual protocol in their (a) rich variety of content, (b) clarity of concepts, (c) degree of organization, and (d) acuity of form perception. McKinnon's study (49), essentially a combination of several case studies, presented instances where inability to attain favorable social adjustment motivated school achievement at the eight- to nine-year level.

Thinking, Reasoning, and Concept Development

The age range from eight to twelve remains as a relatively untouched area for developmental research in problem solving. Among the few available studies are those by Batalla (5) and by Long and Welch (46, 80). Seeds (68) added secondary data in her report on free choice activities engaged in by nine-, ten-, and eleven-year-old children.

In Batalla's experiment (5), children three to twelve years of age were trained in a body maze. After the maze had been learned (three successive errorless trials), clearly obvious changes in the maze pattern were made. The effect of these changes was to enable the subject to go to the exit by a much shorter route. The resulting data showed, both for the younger as well as for the older children, that their maze learning was generally piecemeal; but there was also some evidence pointing to an intermediate process somewhere between trial-and-error and insight.

The investigations by Long and Welch involved children eight to twelve years of age. In one experiment (46), forty children were presented with a series of reasoning problems, all of which were solvable by the same general principle. Subjects who found this principle without assistance tended to be more advanced both mentally and chronologically. Thus mental and chronological ages were found to be factors related to the ability to generalize. In another experiment (80), three methods of inductive reasoning—agreement, difference, and joint agreement-difference—were applied to a series of problems by thirty nine- and ten-year-old children. It was found that most of the children who solved the problems of each method were able to keep the principles separate, even when the methods were presented in random order. Huang's survey (38) led him to conclude that simple and naive physical concepts seemed to be established for even very young children.

Buck, Fitzgerald, and Ojemann investigated thinking from the dynamic point of view. Buck and Ojemann (15) studied some of the factors which determine the adolescent's use of logical thinking in situations where the subject is free to select a course of action. They found a correlation of .31 between the results of a special test of thinking and behavior in free choice situations. In a later article, Fitzgerald and Ojemann (27) conceived of knowledge to be "not exact and static but approximate and changing. . ." presenting "both a probability and a changing characteristic." They constructed a special test to measure various aspects of this dynamic concept of knowledge as it applies to physical, physiological, and mental-social problems. From the data obtained in a sample of 176 juniors and seniors in two midwest high schools, it was found that (a) the development of the concept had not proceeded very far, (b) the development in the physiological area was significantly higher, and (c) the amount of training in courses that might be expected to facilitate the development of this dynamic concept of knowledge did not yield significant correlations.

Language Development

Studies of language development in children have been numerous; yet the recent study by Wells (81) is unique in its attempt to trace the development of the use of abstract language in deaf children as compared to normal children. Some 250 normally hearing children in Grades III thru VI in a small midwestern city were compared with a like number institutionalized in the state schools for the deaf in Iowa, Minnesota, and Wisconsin. Wells found that the average IQ obtained on the Chicago Non-Verbal Intelligence test was some 20 points lower for the deaf group. Wells also noted from an analysis of themes submitted by both groups that the normal group was superior in its use of abstract nouns and words of a relational character.

Other recent studies pertaining to language development verified generalizations previously made. Worbois (85) found that children attending consolidated schools showed definite superiority over children attending one-room rural schools in the same area. Stalnaker (71) reported that the College Entrance Examination Board's English examination revealed a definite superiority of the girls over the boys. This is contrary to the trend for most of the other examinations supervised by the board. Fleming (28) studied the vocabulary growth of Mooseheart children. On the basis of the 1916 Stanford-Binet list, those children whose IQ's were below average were found to have less than the standard annual increase. Davis (24) tabulated the position, in a sentence, of the subordinate clauses occurring in 18,650 remarks made by 375 preadolescent children. She found that subordinate clauses of time and condition were usually found early in the sentence—that 29 percent of her five-year-old sample had already learned this usage; but that the pattern was much more firmly fixed (54 percent) in nine-year-olds.

Memory

Postman and Murphy (62) suggested that emotionally tinged material may cause inhibition of learning in twelve- and thirteen-year-old children. They examined the relationship between their attitudes toward war and memory for material connected with it. Spache's survey (70) of spelling disabilities brought out the remark that the evidence supports some association of spelling ability and various types of auditory memory, altho this is vitiated by the fact that these same abilities are frequently considered indications of general intelligence. Bumstead (16) presented a table (for college students) which showed the number of readings necessary to memorize selections of various kinds and lengths when study periods are placed at intervals of from zero to 192 hours.

Mental Development and Physical Well-Being

Brain injuries—Realizing that impaired mentality due to a physical brain injury differs clinically from feeble-mindedness in nonbrain-injured children, Strauss and Werner (74, 82) devised several tests to show differences in thought processes between exogenous and endogenous mental deficiency. Their Object-Picture test consisted of two pictures: (a) a boy about to drown and (b) a building on fire, before which the subjects were instructed to place those objects which they thought would "go best with each picture." Objects were selected from a standard series of eighty-six human and animal figures, cars, trees, tools, and so forth. Two sorting tests were also used. In the first, the subjects were instructed to "put together those things which go together," given a standard series of fifty-six objects. In the second, the subjects were given one key object which was to be matched with one of several other objects. Nonbrain-injured children responded to these tasks as tho they were logical problems commensurate with their inherent mental ability; while for the brain-injured children the tasks elicited dramatizations of actions taking place in the past and the future as well as in the present. The brain-injured children made a significantly larger number of uncommon (illogical) responses—even when first choices only were considered—and they frequently became so involved in some detail of the situation that they tended to deviate from the main task and build associations around the detail.

Infectious diseases—Many unknown factors still cloud the true relationship between physical damage caused by infectious diseases and subsequent mental development. Bender (6, 7), after observing various types of encephalitis, implied that the virus types were most damaging. She also found that children who sustain a very severe burn in early childhood may in the period of active treatment show evidence of the onset of an acute encephalopathic process which may terminate fatally or gradually regress, leaving the child with real cortical damage.

Byers and Lord (20) reported about twenty school children who had been hospitalized in infancy or early childhood because of lead poison-

ing. The poisoning had prevented the normal processes of growth and development of the cortex. The IQ's of the children ranged from 67 to 109, with all but one failing to progress satisfactorily in school. Lurie and Levy (48) suggested that whooping cough in infancy might lead to intellectual deterioration in some cases.

Diet—Harrell (34) set up an experiment to determine the effect on learning of a two-milligram dosage of thiamine (vitamin B₁) added to the regular diet of children four to twenty years of age. The experiment was carried on in an orphanage, thus giving reasonable assurance that food and general living routines had been comparable for all cases for some time prior to the experimental period, and also remained comparable throughout the experiment.

It was found that in every one of the eighteen tasks investigated the vitamin-fed group surpassed the control group in making gains, although the two groups were initially well matched. The superiority of gain was statistically significant at the 1 percent level in (a) code learning and (b) underlining 4's; and at the 5 percent level in (a) reading speed and accuracy, (b) division, (c) number span, (d) left-hand grip, and (e) addition.

Meloan (53) suggested that excessive appetite occurs as a symptom of maladjustment in children of normal or superior intelligence.

Popularization of Research

A significant aspect of the research on mental development during recent years is the trend toward popularization of both the actual findings, as well as of the implications of such findings. Illustrative of a comprehensive popular account of developmental data is Jones's case presentation of "John Sanders" (41), based on data gathered during the California Adolescent Growth Study. Zeligs (86) interpreted for parents the feelings, wishes, worries, aims, and ambitions of twelve-year-old children relative to the home, the school, and the social world, based on her examination of thousands of children. Even textbooks on adolescence begin to reflect the popular trend (21).

Representative of the many shorter popular articles reflecting the findings of recent research in mental development are: Bloss's summary of known facts about character development in early adolescence (9); Haefner's behind-the-scenes account of a case interview based on the Kent-Rosanoff free association test (32); Redl's characterization of the pre-adolescent (63); Seagoe's review of the implications for teaching when the child, not the teacher, is made the active agent in a school situation (67); and Theobald's case summaries of three early adolescents who were educationally maladjusted in scholarship, or in ways of behavior, or both (77).

Research Technics and Materials

Research workers in mental development have been slow to avail themselves of newly developed technics and materials. Factor analysis (29, 37,

75), for example, received scant mention in the mental development literature. Neither has the concept of organismic age (59) been explored fully. The concepts, materials, and technics suggested by Smith and Tyler (69), as an outgrowth of the Eight-year Study, opened new avenues of research in mental development, which have not been utilized to any great extent. Trimble and Cronbach (79) suggested a practical procedure for the rigorous interpretation of test-retest scores in terms of pupil growth.

McNemar's analysis (50) of the standardization data for the 1937 revision of the Stanford-Binet scale has made that scale more meaningful to research workers; Terman and McNemar's revision (76) of the Terman group test of mental ability was timely; but Berger's statements (8) to the effect that IQ inconstancy remains dependent upon factors inherent in test construction pointed to the need for continued research on intelligence test construction—particularly group intelligence tests.

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CHAPTER V

Physiological Aspects of Development

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FOR CONVENIENCE OF PRESENTATION, the entire developmental sequence has been divided into the following general periods: (a) prenatal, (b) birth and neonatal, (c) preschool and childhood, and (d) adolescent. Because of the wide individual differences in rates of development among normal children, specific chronological age limits for these general periods have been scrupulously avoided.

Prenatal Development

Fetal circulation—Prenatal or fetal development is characterized by physiological dependence on the maternal organism. During this period nutrition, respiration, and excretion of the fetus are maintained thru maternal organs by way of the placenta (142). Materials required for growth and development of the fetus, such as nutrients, water, and oxygen, are exchanged by diffusion from the maternal blood across the placental membrane into the fetal blood, while products for excretion, such as carbon dioxide, urea, and so forth, formed by the fetus, diffuse from the fetal to maternal blood (87, 142). Satisfaction of the physiological needs of the fetus is thus dependent on an adequate circulation of its own blood, accomplished by the fetal heart, and the maternal circulation thru the uterine wall to which the placenta is attached. A great deal of interest has centered around the fetal heart as an index of fetal condition and behavior. Obstetricians have long used the fetal heart rate as an index of fetal condition at birth, regarding an acceleration as an ominous sign of fetal asphyxia. Sontag and Richards (124) have found that relatively early in development the fetus responds to both internal and external stimuli with an acceleration of heart rate. Among other external stimuli, the fetus is particularly sensitive to vibratory stimuli, and attempts have been made to produce prenatal conditioning. But no clear-cut instance of prenatal conditioning has yet been recorded (99, 125, 126). Richards and Newbery (100) have reported a positive relationship between fetal activity as reported by the mother and performance on the Gesell test items at six months in a series of twelve infants.

Fetal nutrition thru the placenta—Since everything the fetus receives or excretes must pass across the placental membranes, a great many studies have been made of placental permeability (87). These studies indicate that the chief determinant of what will or will not pass from mother to fetus (or vice versa) is the molecular size or weight of the substance. Thus all the simple carbohydrates, electrolytes, amino acids, water, carbon dioxide, oxygen, and nitrogen pass readily by diffusion from areas of higher concentrations in the maternal to areas of lower con-

centrations in the fetal blood. The transfer of fats is complicated by chemical changes which may occur in the placenta (50, 142). A great many drugs will easily diffuse from the maternal to the fetal circulation. This fact becomes of some importance when analgesics are used to eliminate or reduce maternal pains of childbirth. Certain drugs, such as morphine, depress the sensitivity of the respiratory center. The use of such drugs to allay pain in the mother may have a deleterious effect on the fetus by reducing the sensitivity to stimuli which normally initiate independent, postnatal respiration (142). Some workers believe that with the proper choice of analgesic, no danger of fetal asphyxia exists (64), but more clinical observations are needed before final judgment can be passed.

Recent studies have also shown that the permeability of the placenta is not a fixed quality, but changes with gestation (39).

Certain endocrine secretions pass not only from mother to fetus but in the reverse direction. For instance, it has been reported that the insulin requirements of mothers become less during pregnancy because insulin produced by the fetal pancreas diffuses into the maternal blood and serves to provide a part of her insulin needs (83, 122). On the other hand, other endocrines, such as those of the sex glands, parathyroids, or pituitary gland, probably do not pass the placental barrier under normal conditions (142).

Effect of maternal diet on fetal development—The avidity with which the fetus absorbs materials essential for its development from the maternal circulation often places a severe strain on the maternal organism. For instance, if the maternal intake of calcium is inadequate, the fetal need will be met by removal of calcium from the maternal teeth and bones. Thus, it is relatively difficult to produce dietary inadequacies in the fetus. The regulation of fetal weight by limitations on the maternal diet can be effected only within certain limits. Nevertheless, an adequate maternal diet is important for the developing child as well as for the mother during pregnancy. Fewer birth complications and improved postnatal development have been reported in infants whose mothers received adequate vitamins and proteins during pregnancy (19, 20, 35). In animal experiments, where severe dietary deficiencies can be induced, restriction of vitamin A intake resulted in auditory defects and structural anomalies in the offspring (80). Congenital skeletal malformations were also observed in 45 percent of the offspring of female rats fed a vitamin D deficient diet (136). Warkany and Nelson (137) have demonstrated other skeletal anomalies in offspring of rats which they believe are due to deficiencies of riboflavin in the maternal diet (138).

Birth and Neonatal Development

At birth the fetus is required to make a number of physiological adjustments. Some of these adjustments associated with independent existence, such as respiration, must be met immediately and effectively, while others, such as regulation of body temperature, may be completed only

after many months. Thus, birth is often a traumatic experience. However, the picture of contented intrauterine existence so often painted by psychoanalysts is not in accord with physiological facts. Experiments on animals have shown that as pregnancy progresses, the amount of oxygen delivered to the rapidly growing fetus becomes less and less adequate, so that existence *in utero* may ultimately become intolerable to the fetus because of impending asphyxia (5).

Changes in circulation of the blood at birth—At birth important changes in the circulation of the blood of the fetus take place (7, 142). In the fetus, very little blood is pumped thru the lungs because of the high resistance encountered in the capillaries of the deflated organ. Hence, most of the blood from the right ventricle passes thru the ductus arteriosus into the aorta. After passing thru the rest of the body of the fetus, the blood is returned to the right auricle mixed with oxygenated blood which has returned from the placenta. In the fetus there is an opening, called the foramen ovale, between the right and left auricles. During fetal life, part of the blood passes directly from the right to the left auricle. At birth, inflation of the lungs with the act of independent respiration lowers the resistance to the flow of blood thru them. At the same time, the muscle fibers in the wall of the ductus arteriosus contract, thus shutting off the flow of blood from the right ventricle to the aorta and forcing all blood from the right ventricle thru the lungs, where it takes up oxygen. With the closure of the foramen ovale, which normally occurs soon after birth, the adult type of circulation is established.

Initiation of respiration and neonatal anoxia—The stimulus to independent respiration is the accumulation of carbon dioxide in the circulating blood of the fetus (142). Under conditions of normal oxygenation, this occurs quickly when the placental circulation is interrupted and independent breathing is established. However, under conditions of anoxia of the fetus, which may occur with difficult and prolonged birth, the sensitivity of the respiratory center to carbon dioxide may be depressed so that it fails to respond to the usual concentration of carbon dioxide (143). Under such circumstances, a mixture of carbon dioxide and oxygen administered to the infant will usually initiate respiration (145). The possible importance of anoxia at birth on subsequent mental development has only recently been recognized (26, 67, 110). Studies on animals and humans now lead to the belief that even short exposures to severe anoxia may result in permanent structural damage to brain tissue (23, 133). Investigations have also shown a high proportion of prolonged and difficult births among children showing mental defect at a later age (22, 67, 110). Animal experiments have shown impairment in learning ability and abnormalities in behavior in rats and guinea pigs subjected to anoxia prior to and at birth (144). McPhail and Hall (75) administered the Kuhlmann-Anderson Intelligence tests and the Haggerty-Olson-Wickham Behavior Rating schedules to 270 school children who, at birth, had received oxygen until respiration was established. These children, who were

apneic at birth, gave no evidence of mental retardation. Until similar negative results are reported in other studies on children, it seems wise to regard anoxia at birth as a potential hazard to subsequent mental development.

Birth injury—Birth also offers potential hazards to the fetus for mechanical injury, particularly the brain. Even minor head injuries produced at birth may have far-reaching effects on later development. These effects may range from gross motor impairments, such as paralysis or lack of motor coordination, to defects in mental development which become apparent only after three or four years (10). Older mothers are more apt to experience difficulties in giving birth to their young, and the effects of slight, undetected injury to the infant at birth may be the basis for reports of retarded mental development of children of older mothers. Since anoxia at birth may also produce unnoticed damage to brain tissue, the entire question of the effect of birth order, age of mother, and so forth, on mental development needs careful reexamination (118).

Initiation of the digestive processes—The digestive enzyme systems are apparently present in the gut even before birth (142), so that the chemical substances required for the digestion of food are immediately available. In fact, the fetus swallows amniotic fluid while *in utero*, and substances added to the amniotic fluid may be detected in the urine of infants shortly after birth. When substances impervious to X-rays are injected into the amniotic sac, they are swallowed by the fetus; subsequent X-ray photographs of the uterus show in detail the gastrointestinal tract of the fetus (142). The fetus may be induced to swallow more actively by injecting saccharin into the amniotic fluid (34). The establishment of digestion in the newborn is characterized by irregularities in secretion and motility which, within several months or a year, give way to the adult state (84, 123). Much experimental work remains to be done on the way in which the digestive processes become stabilized.

Initiation of urinary excretion—The minimal secretion of urine in the fetus before birth is due chiefly to the low blood pressure present. At birth, the character of the circulation changes and the blood pressure rises (142). Since the formation of urine in the kidney is partly a filtration process dependent on the height of the blood pressure in the kidney, the increase in pressure immediately results in the formation of a larger volume of urine. The ability of the kidney to excrete urea is low immediately after birth (146) and apparently the dilute character of the urine of the newborn is related to functional immaturity of the kidney tubules, since posterior pituitary hormone is ineffective in inhibiting water diuresis in young animals.

Temperature regulation—The ability to regulate body temperature is an important physiological function which is developed only gradually during postnatal development. In fact, children up to six years of age may show considerable fluctuation in body temperature (8). The control of body temperature involves a coordination between nervous, cardiovascular, and

respiratory functions which is apparently attained only after considerable time.

Childhood Development

Physiological changes—Physiologically, the childhood period lacks the dramatic incidents of the preceding pre- and post-natal periods or the following adolescent period. Normally this period is characterized physiologically by a gradual diminution in growth rate, basal metabolism, and pulse rate, and a gradual increase in blood pressure, cardiac output, creatine excretion, muscular strength, and absolute body dimensions.

Influence of age norm comparisons—Altho we know little of the effects of an emphasis on "normality" on the child himself, we have amassed an intensive literature on so-called "age norms" for a great many variables. A staggering literature has accumulated on physical growth (60, 65, 81, 82), but many of these studies add little to our understanding of growth beyond that projected by Baldwin (4) or Porter (97) in their original studies made over twenty-five years ago. The more useful studies of growth are those which have brought to focus the importance of individual differences in growth rates and the limitations of average growth curves in describing the growth pattern in individual children (27, 31, 42, 43, 53, 92, 119). The description of growth changes in physiological functions has, with a few exceptions, tended to follow the same general pattern, except that fewer subjects have been observed. There is a need for the systematic observation of children thruout this age period.

Incidence of physical defects in children—Numerous "surveys" have provided information about the relative incidence of various kinds of physical defects in school children. In examining this extensive literature, certain precautions in interpretation must be observed. In the first place, it is found that examiners tend to find that for which they are looking. Thus, a much higher incidence of tuberculosis is usually reported in school surveys having emphasis on tuberculosis (6) than in school surveys having emphasis on goiter (90) or dental caries. Even when some account of this magnification is taken, the incidence of physical defects, such as enlarged tonsils and adenoids, faulty vision, faulty hearing, and carious teeth, remains all too high in the school population. Recent data obtained from physical examinations of selectees emphasized the high incidence of certain physical impairments such as faulty vision, dental caries, and so forth, in the young adults of this country (37, 105).

Control of dental caries—The problem of dental caries deserves special mention. While the *final* cause of dental decay is admittedly the action of acids on the dental enamel at the dental plaque, the factors that lead to mouth conditions permitting dental decay are still obscure.

Many dietary factors have been regarded as important in determining the incidence of caries, but careful studies have shown that no single factor can be identified which will accelerate or retard caries in all children. For instance, high intakes of refined sugar may produce mouth conditions

conducive to decay in some children, but sharp reduction in sugar intake in such children will not prevent all decay (13, 21, 24, 38). Similarly, increased dietary intake of calcium, phosphorus, or vitamin D will not inhibit caries, altho a few children (but not all) show a reduction in decay under such dietary improvement (21, 28, 77, 104). General dietary supervision, without recourse to special administration of minerals or vitamins, proved equally effective in reducing caries (49, 69). Excessive administration of vitamin D has been shown to produce malformation and malocclusion of teeth in experimental animals (9). More children were caries-free among those who brushed their teeth daily than among those who used the toothbrush occasionally or not at all (17), but excessive or improper use of the toothbrush was associated with a high caries incidence (57).

The recent finding of entire communities in which caries were absent in children has stimulated research to discover dietary factors which might be responsible. It has been found that there is a small amount of fluorine in the drinking water in these communities which apparently inhibits dental decay (1, 29, 30, 32, 73). Animal experiments have shown that small amounts of fluorine are most effective in preventing decay if present at the time the tooth enamel is being laid down (prior to eruption) (72, 73). The addition of fluorine to drinking water thruout the country as a prophylaxis against dental caries cannot be lightly recommended because of the great toxicity of fluorides. While the presence of 1-2 parts per million of sodium fluoride in the water is apparently sufficient to inhibit caries, the presence of 10-12 parts per million caused the deposition of unsightly "mottled enamel" on teeth (74). The continued ingestion of even small amounts (greater than 20-25 parts per million) can be dangerously toxic because of the cumulative effects. For this reason, the application of dilute solutions of sodium fluoride to the teeth has been tried. In some instances, the formation of new carious surfaces has been inhibited for as long as eighteen months following a single local application of sodium fluoride. This procedure holds the promise of effective control of caries and warrants further intensive study (3, 11, 12, 22, 63). The local application of liquid detergents or urea solutions has also proved effective in some studies (128). Research has indicated that it is during this childhood period that the caries problem may most effectively be met and solved.

Effects of diet on growth and performance—The effects of diet on mental development have also been studied in children of school age. Earlier studies which reported improvements in school performance following the administration of various nutrients have been critically evaluated in previous reviews (112, 116, 118). Some recent studies have reported decreases in fatigue and improvement in school performance of mentally retarded (129, 135) and normal (48, 66) children following improvement in nutrition, including the administration of vitamins of the B complex. While these studies are suggestive they are not conclusive, as indicated by negative results obtained by other investigators (41, 44, 62, 93). Other studies have

reported a diminution in work output in subjects placed on diets restricted with respect to vitamins of the B complex (40, 91, 141). Output of physical work diminishes within a few days when the B vitamins are removed from the diet of persons undergoing hard physical labor daily (54). The reduction does not appear as rapidly in sedentary workers but increased fatigue occurs within one or two weeks. These effects disappear quickly when vitamin B complex is returned to the diet. Williams and others (141) have reported increased fatigue and irritability in women maintained on diets which were only slightly more deficient in vitamin B than that consumed by a large proportion of the American population. Emotional disturbances are often observed in patients suffering from a deficient intake of vitamins of the B group (55, 111, 127, 140). Since subclinical vitamin deficiencies may be widespread in the American population, the importance of such studies is apparent. If "laziness" is only an expression of dietary inadequacy, the social implications of such studies are enormous. On the other hand, excessive dosing with vitamins does not seem to improve the work output of young adults with adequate vitamin intakes (62, 121). The whole field is one in which carefully controlled studies with purified vitamins are sorely needed.

Adolescence

Endocrine factors in adolescence—Physiologically, adolescence is characterized by the increase in growth tempo, and by the especially rapid maturation of the sex glands and accessory organs which have been dormant. A number of hormones are secreted by the pituitary gland which are of chief importance in adolescent changes. The gonads of both boys and girls are stimulated to produce greater amounts of the male or female sex hormones respectively. These sex hormones regulate the development of the secondary sex characters (43, 109). In animals, many experiments have shown clear-cut influences of the sex hormones in inducing sex behavior. In humans, the relationships are not so clearly indicated, altho it is reasonable to suppose that the endocrine changes at adolescence provide the basis for the awakening of interests in the opposite sex (59, 106). The secretion of the thyroid gland evidently takes part in the generally increased growth tempo of adolescence, since it is at this age that an enlargement of the gland occurs, particularly in regions where the intake of iodine may be deficient (so-called adolescent goiter) (52, 90, 130). This increased secretory activity is reflected in a rise in the basal metabolic rate in some children (113, 115).

Individual growth curves of physiological functions—During adolescence, the pulse rate diminishes, systolic blood pressure rises (115, 117), total respiratory volume increases, and basal metabolism diminishes on the average (89, 113). Altho average growth curves for all these physiological variables are quite smooth—indicating a gradual transition with growth, just the opposite is found when growth curves of individual children are examined (115). Such an analysis stresses two important char-

acteristics of adolescent development: (a) in individual children sudden and rapid changes in physiological characteristics are frequent and (b) the rate of physiological maturation differs greatly for different children. During adolescence, wide fluctuations in such measurements as basal metabolism, pulse rate, skin resistance, as well as the marked irregularity in length of the menstrual cycles with the beginning of menstruation in girls (36), lead to the conclusion that adolescence may be regarded as a period of "physiological learning" during which the organism "learns" to utilize and coordinate the numerous mechanisms involved in maintaining the more evenly regulated physiological state of the adult. As maturity is reached, variability in physiological functions diminishes.

Endocrine therapy in growth pathology—With our increased knowledge of the role of endocrines in growth and development, children with marked retardation in physical growth or sexual development may be successfully treated. Among stunted children, administration of thyroid substance, pituitary growth hormone, and even male sex hormones has been followed by increased growth in height. Pituitary gonadotropic hormones, as well as male and female sex hormones, have been used successfully in the treatment of retarded sexual development in both boys and girls. However, such therapy is not yet advanced to the state where it is generally available, and, moreover, the hazards and potential difficulties are still great enough to preclude general use of these hormones.

Acne in Adolescents

Adolescent acne has been attributed to an imbalance between the secretion of male and female sex hormones, and some reports of successful treatment by means of hormones have appeared (16, 45, 68). However, recent studies have reported successful treatment of acne by dietary regulation, and the administration of vitamins of the B complex (56, 132). While the control of acne may be of secondary importance from a physiological standpoint, its psychological importance to the developing adolescent cannot be overemphasized.

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CHAPTER VI

Physical Growth from Birth to Maturity

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IN THIS REVIEW investigations have been selected which seem to represent the present emphasis both as to areas studied and methods or technics used.

The Curve of Growth

The present emphasis seems to be not so much the establishment and comparison of group growth curves, but rather the establishment and analysis of individual growth curves from well-planned, carefully controlled long-time studies of large numbers of individuals. Wolff (54, 55) in the Hagerstown, Maryland, study made yearly measurements from 1937 to 1940 of a large group of girls and boys. He concluded that it is not so much sex differences but growing height which determines weight. None of the three indexes used remained constant over the whole growth period. He concluded that growth cannot be measured by the same height-weight ratio at different ages.

Wolff (55) also discussed the tendency for recent child population groups to show an increase in weight. He noted smaller families as a possible explanation; also that, in Washington County, higher socio-economic groups since 1920 have contributed a larger proportion of children than in former years.

Robinow (40) established norms for the variability of weight and height increments from birth to six years of age. Since no sex differences were present he combined the data into one set of norms. During the first year of life the ratio of growth decreased rapidly and height was less variable than weight as regards increments.

Vickers and Stuart (47) have recognized the relation of body size, proportions, and rate of growth to physical health and fitness, and have pointed out the importance of periodic observations to prevent retardation. They suggested three measurements: (a) body weight, (b) height (recumbent length), and (c) breadth of chest and pelvis (recumbent) as being most useful to the pediatrician.

Growth in External Dimensions and Body Form

Bayley (5) contrasted the bearing of skeletal maturing with that of chronological age on growth in absolute size. Comparisons were made for a group of ninety boys and eighty-seven girls. The samples were divided into early, average, and late maturing groups, and compared on four anthropometric dimensions. The data for girls showed late maturing

¹ The helpful assistance of A. S. Wesman is hereby acknowledged.

girls to be short in early age, but tallest after 15.5 years. The reverse was true of early maturing groups. The average group took a mean course.

Bayley (6) also analyzed the X-rays of the left hand and knee for the same group of children. The X-rays were made at six-month intervals for four and one-half years. She concluded that the growth size is closely related to the maturing of the skeleton and that maturing size can be predicted with fair accuracy from present size and skeletal age.

Olson and Hughes (38) proposed an "organismic age" as a unit in the study of child development. "Organismic age" is the average of growth values for a given chronological age, i. e. age is the average of mental age, dental age, reading age, weight age, height age, carpal age, and grip age. Growth increments tended to be proportional when studied relative to "organismic age."

Cinema records have been put to more and more ingenious uses. Ames (1) analyzed the detailed cinema records of a group of infants (records were made at monthly intervals from ages four to fifty-two weeks) in an effort to characterize the supine leg and foot postures in the first year of life. Summaries were made of the monthly age levels. The general trend for legs and feet was from flexion and inversion to extension and eversion.

Goodman (22) studied the absolute width and depth of the thorax during the first postnatal week and the trend of change in the thoracic shape of thirty-six boys and thirty-two girls. The width and depth of the chest decreased during the first half of the first week. During the last half of the first week, the transverse diameter failed to change, but the antero-posterior diameter increased significantly.

Components of Stature

A unique approach to a detailed study of one infant is that of Gesell and Halverson (19). Daily cinema records (220 in all) were made of one infant from the fifteenth day to the two hundred thirty-fifth day of age, supplemented by weekly records for the remainder of the first year of life. Three behavior situations were recorded: (a) The anthropometric or "full length" record, (b) the reactions to a moving ring, and (c) the reactions to a stationary ring. The head, eye, arm, and leg behavior of the infant were analyzed in an attempt to describe the neuromotor development as shown by the change in behavior as related to age. Visual attention, visual reaction to both static and moving objects, the coordination of the ocular and manual grasping, the tonic-neck reflex, laterality, leg and arm movements were studied. The authors concluded that growth is gradual and progressive rather than revolutionary or saltatory.

An equally ingenious study was carried on by Ling (28). He proposed to study (a) the nature, occurrence, and development of sustained visual fixation, (b) various types of eye movements involved in fixation, (c) postural responses during fixation, and (d) other phenomena related to fixation. He used an experimental cylinder so constructed as to rotate

freely. The child was placed in the experimental cylinder so constructed that the crib moved back and forth. The stimulus object was a black disk of velveteen two inches in diameter which could be raised or lowered at will. A motion picture camera was used to make the records. The infant was placed in the crib inside the cylinder. The disk, lowered to a position slightly above the bridge of the nose, equidistant between both eyes, was moved back and forth. Cinema records were taken of the ocular and head behavior of the child. Twenty-five infants were studied ranging from seven minutes of age to twenty-four weeks. The cinema records were analyzed both as to sequence of changing behavior patterns and as to units of behavior. Ling concluded that sustained visual fixation is absent at birth, but begins a few hours after birth and reaches a peak at four or five weeks. Infants respond differently to near and far position.

Studies very similar both in purpose and method of approach to the Yale Studies are those of McGraw (32) and McGraw and Breeze (33). In the former, McGraw has attempted to rate selected behavior activities as predominantly of two neural levels (a) subcortical and (b) cortical, and to find the periods of major transition from level to level. The 1717 observations of eighty-two infants (some written, some films) were analyzed relative to (a) muscular coordination involved in moving from a recumbent to a sitting position, and (b) movements which occur after reaching a vertical position.

McGraw and Breeze (33) determined whether serial observations of sequential development of behavior could be reduced to mathematical expressions of the dynamic element of change which transforms one form of behavior into the next. The child and an impression of the footprint during walking were photographed at varying intervals. Certain spatial factors were determined by tracing the center of gravity of the body. Curves of the percentage of time each foot was in action during a step showed the course of bilateral integration.

Factors Conditioning Growth

Geographic and temporal factors—Wise and Meredith (52), in a report of the physical growth of Alabama white girls attending WPA preschools, ascertained information on body size and form of white females from impoverished socio-economic groups. This group was contrasted with two groups of Iowa children from professional and managerial classes. For each of fifteen anthropometric measures ninety-two values were obtained. The Iowa and Alabama groups were carefully matched. With few exceptions the means for body size for the Iowa groups exceeded those for Alabama. The differences tended to be larger at five years than at three years.

Goodenough (21), investigating month of birth as related to the socio-economic status of parents, grouped 3275 children as to socio-economic status. Birth month was about equally divided among the four seasons for children from the three lowest occupational groups, but a decrease in

winter months and an increase in spring and summer months appeared for children in the three highest occupational groups. From questionnaires sent to pediatricians and women of superior economic levels, Goodenough concluded that superior parents arrange for birth of child in spring months. This seemed to explain the small observed differences in intelligence of children grouped relative to month of birth.

Meredith (36) reported the stature and weight of children of the United States with reference to the influence of racial, regional, socio-economic, and secular factors for two age levels (nine years and fourteen years). Both white and Negro boys of high-school ages living in the United States today were taller and heavier than was the case half a century ago. White boys of professional groups were larger than those of unskilled groups. Meredith has pointed to the need for controlled studies on the above question.

Race—A comparison of Negro and white infants which covered 679 observations on 114 infants was made by Bakwin and Patrick (2). The means and standard deviations of weight of the Negro infants were compared with those for white infants. No significant differences in weight gain were found during the first year of life.

Heredity—Gesell and Thompson (20), in a biogenetic study of individual differences of identical twins, observed twins T and C from infancy to fourteen years of age. Careful records were kept of the physical development, language, motor, and personal-social behavior of the twins. T was the experimental twin. C was the control twin. The material collected included stenographic notes, cinema records made at periodic intervals, ratings, and characterizations.

Some of the findings were: T was smaller; had the first tooth; her permanent teeth erupted earlier, and she reached the menarche sooner. The skin, eyes, hair, palm and finger prints of the twins were remarkably alike. T's motor behavior and posture were better, but C was slightly better in intellectual activities. C was more talkative. C had a slightly more acceptable personality. The twins have followed almost identical time tables postnatally and doubtless prenatally also. The acceleration of T was so slight and restricted as to have little perceptible effect.

Ebert and Simmons (15) published the first of a series of reports which will summarize the findings of the Brush Foundation Study of the growth and development of a large number of Cleveland children. In Section IV, Ebert discussed the results of the study of sibling resemblance in intelligence. The correlations of Stanford-Binet IQ's of siblings at each age level from three to nine years showed a range of from $r = .324$ to $r = .551$. There were no consistent changes in the correlations from age level to age level. There was a tendency for like-sex sibling correlations to be higher than those for opposite-sex siblings.

The mental growth patterns for twins with test records covering six or more years were also studied. The sample was small—five pairs of like-sex

twins and one pair of opposite-sex twins. The opposite-sex twins showed as much resemblance as the like-sex twins, and in some cases the resemblance of twins was not much greater than for some siblings.

Illness—Martens and Meredith (30) studied the relation of amount of illness over a six-month period to selected measures of body size and form and rate of growth. An exhaustive study was made for a single age group (fifty-four boys and thirty-six girls) ages four years nine months to five years ten months. No relationship was found between illness and any of the measurements made.

Wetzel (50) has continued his development of methods of assessing the physical conditions of children, by an analysis of the resultant physical breakdown into constituent elements of physique, development, and nutritional grade. He has stated the importance of two steps in assessing physical conditions: (a) the evaluation of physical status, and (b) the evaluation of physical progress.

By means of photographs of children grouped into paths which correspond to channels on the Wetzel Grid, he has shown that the body build or physique for all children in the same channel is essentially the same, irrespective of level of development, and that increasing the level within the channel corresponds to an increase in size, but produces no significant changes in physique or body build. Children within the same channel, irrespective of size, have the same shaped head, neck, shoulders, thorax, hips, thighs, and legs.

Activity—Weech and Campbell (48) have stated that the correlations of behavior with a function of body weight which measures the rate of gain are high. These correlations are high enough to suggest that the significance of individual achievement in behavior can be assessed more accurately if consideration is given to the past record of the infant in respect to weight. Quantitative measures of development in creeping, sitting, and walking were correlated with body weights of thirty-three infants at fifty days of age, and with percentage increases in weight from fifty to 150 days.

Diet—Lewis, Bodansky, and Haig (27) placed 144 infants on varying diets of vitamin A content. The intake compared to the level in the blood and the relation of vitamin A intake to dark adaptation was determined. Low levels of vitamin A in the blood occurred when infants received diets devoid of vitamin A or had disorders which caused an interference of the absorption of fat. Low level of vitamin A in the blood was associated with poor dark adaptation.

The influence of diet on the physiologic anemia of infants was reported by Brokaw, Sedam, and Cassirer (8). Physiologic anemia has been thought to occur around the sixth to ninth month. During a two-year period, 177 normal infants were studied. Three diets were used: advanced, average, and control. The hemoglobin and red blood count levels showed no differences, but weight, height, and muscle tone were benefited by the "advanced" diet.

Macy, Hummel, and Shepherd (29) found the ability of different subjects to decompose fiber varied widely, but less variation occurred with older children. This was the result of roentgenographic studies of gastrointestinal tracts to determine rate of passage of food residue.

In a discussion of simple malnutrition, Wetzel (51) pointed out the urgent need for an early recognition of the problem.

Pubescence—Dorff (14) presented case histories of two boys. One was a sexually underdeveloped, tall youth (age twenty-one years). After receiving 400,000 units of chorionic gonadotropin and some testosterone during twenty-two months, the height and weight increased, secondary sex characteristics appeared, and the epiphyses were almost united. The second boy (age eleven and one-half years) was fifty-four and three-quarters inches tall, weighed sixty-two pounds, and with the osseous status of a boy eight years of age. After receiving 82,000 units of chorionic gonadotropin in thirteen months he became well developed, height and weight increased, and ossification was only nine months retarded.

The relation between physique and intelligence, temperament and personality, in superior adolescent boys was analyzed by Fiske (17). The boys were grouped into body types by Sheldon's somatotype technic. An analysis of variance showed no relationships of variables to somatotype. Child and Sheldon (11) correlated the components of physique and scores on psychological tests. College undergraduates were grouped into three body types. Correlations were low, and are of dubious reliability. The static and dynamic physical fitness of adolescents was investigated by Gallagher (18).

A study concerned with the interrelations of certain maturational indicators was reported by Simmons and Greulich (44). Two hundred girls from the Brush Foundation Regular Series were examined on each birthday from ages seven to seventeen years. For the seven to fifteen years group, the mean standing height of girls with early menarches was invariably greater than that of girls with late menarches. For the seven to sixteen years group, the mean weight of girls with early menarches was also greater than for girls with late menarches. Girls with early menarches advanced in mean skeletal age over girls with average time of menarche. Girls in late menarche group had lower skeletal ages. The year of maximum increment in height appears just before the menarche. The values of maximum increments for both height and weight are negatively correlated to menarcheal age (girls with early menarche have greatest acceleration followed by greatest deceleration). Skeletal age was more highly correlated with menarcheal age than was height, weight, or annual increments in height.

Appraisal of Physical Status: Build and Weight

Dentition—Massler, Schour, and Poncher (31) have said: "The enamel and dentin in the formative and calcifying states of growth serve as kymographs on which are permanently recorded the physiologic or patho-

logic changes in metabolism that occur within the organism." One thousand human deciduous and permanent teeth were studied in ground and decalcified sections.

Data on eruption and caries of the deciduous teeth reported by Doering and Allen (13) indicated a consistent pattern of eruption of deciduous teeth. The age of eruption and rapidity of dentition showed large variance.

Seasonal variations in the incidence of dental caries were recorded by Lathrop (26). Tests were made in September 1940, January 1941, May 1941, November 1941, and April 1942 on eighty-two school boys (ages nine to twenty-two years). He found the greatest immunity during the summer and least during the winter.

Ossification of the skeleton—The relation of calcium, phosphorus, and nitrogen retention to growth and osseous development was studied by Daniels (12). Three skeletally retarded preschool boys were studied for nine months. Skeletal age was determined by four standards: Flory, Todd, 50th and 90th Harvard percentiles. Calcium and phosphorus ingestion were constant, and the average calcium, phosphorus, and nitrogen retentions remained high. The children showed large gains in height and weight.

Robinow (41) stated that appearance of ossification centers roughly follows a standard time, but irregularities in time make skeletal age by the Todd or Flory atlases difficult to determine. He proposed to demonstrate the existence of groups of ossification centers, and to show that if one center were retarded, all centers of that group are retarded. The inter-correlations of "appearance time" and nineteen centers were factor analyzed. Three factors appeared: "round bone," "epiphysis," and a third which had no obvious meaning. He established an atlas with three standards for each age group.

Reynolds and Sontag (39) made a study of seasonal variations in weight, height, and appearance of ossification centers. They observed 133 children at the Samuel S. Fels Research Institute during an age span of twelve to sixty months. They found seasonal variations for height, weight, and number of ossification centers. The variations were similar for boys and girls.

The ages of the beginning of ossification in the distal epiphysis of the ulna, the first sesamoid of the thumb, and the crest of the ilium were studied by Buehl and Pyle (9). They examined sixty children. The ages and the concomitant mean total skeletal ages were correlated with the menarcheal ages. The iliac age was compared with the menarcheal age in an additional one hundred girls. They found that ossification began in these centers according to the normal order of general development peculiar to each sex, i.e. boys follow girls in sequence of ossification. The ages at the beginning of ossification correspond more closely with menarcheal age than did the mean total skeletal age in this group.

Growth in body structure and internal organs—Stuart and Dwinell (46) outlined a new technic for the study of children six to ten years of age. The method evaluated the relative amount of three principal tissues of

the body by X-ray films of the leg. An exhaustive study of pulse and respiration rates of eighteen boys and twenty-five girls was made by Halverson (24). The pulse, costal and abdominal respiration, and arm and leg movements were recorded kymographically in eighteen different situations. The study was carefully controlled and various breakdowns of data were analyzed from several different points of reference which permitted control of more variables and a more detailed description of each pattern of behavior. Benjamin and Weech (7) studied the day to day variation in basal heat production. The basal heat production of the infants showed large fluctuations.

Shock (43) studied basal oxygen consumption of fifty boys and fifty girls. Average values of basal oxygen consumption were expressed in cubic centimeters per square meter per minute. Basal heat production was expressed in calories per square meter per hour. These values were selected as the best method of expressing normal values over the adolescent period.

Campbell and Weech (10) sought to discover evidence of maturation in the central nervous system from the pattern of development in creeping, sitting, walking, reaction to a pin prick, and reaching for a lure. An analysis of variance was made for both variation of activity and variation of age at zero development. The results suggest development of centers in the nervous system which act to coordinate activities. McGraw (34), from a study of rotary vestibular reactions of infants, concluded that the development in the reactions may reflect maturation essentially in the subcortical nuclei. In another study of the neural maturation of the infant, McGraw (35) described the neuromuscular changes in the achievement of an ability to turn from a supine to a prone position. Engel (16) compared the growth of the lung in healthy and sick infants. He found the lung of the normal infant grows fastest in the first few months, doubles its volume by the third or fourth month, and quadruples it by the end of twelve months. The growth of the lung was found to react in infancy to the slightest change in general physical condition.

Technics of Research in Physical Growth and Anthropometry

The recent trend in child development research is the longitudinal study of many individuals, in which interrelations of many variables are studied thru the cooperation of specialists in many fields. Jones and Bayley (25) gave a general report of the Berkley Growth Study. This study will cover the mental, motor, and physical development begun at birth and continued to maturity.

Wetzel (49) has proposed a technic for appraising the physical condition of a child. Baum and Vickers (4) outlined a planned technic of examination for anthropometric and orthopedic examinations. Smith and Boyarsky (45) have reported a study of the relationship between physique and simple reaction time. Robinow, Leonard, and Anderson (42) have described a new approach to the quantitative analysis of children's posture.

The studies reported in the past two years show an increased tendency toward rigorous experimental design and control. The sample to be studied is in many cases more carefully selected, more variables are controlled, and more elaborate statistical analyses are applied.

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CHAPTER VII

Intellectual Changes During Maturity and Old Age

IRVING LORGE

SINCE THE LAST REVIEW of this topic, most of the references in this area of study have been concerned with the results of intelligence tests in psychosis. Generally, the estimation of intellectual deterioration in abnormal states implies a correction for changes in score and in quality of intellectual performance as a function of age. The accumulation of evidence concerning intellectual changes in maturity and old age definitely indicates that as people grow older their test performances change. It is clear that intellectual changes as a function of age create problems concerning the interpretation of adult scores and adult intelligence quotients; the relationship of previous education, experiences, and skills to measurement of adult intelligence; the factorial composition of adult intelligence tests; the relationship of intelligence test scores in childhood and youth to such measures in adult populations; and the standardization and norming of adult intelligence tests. Perhaps the most significant new development is the demonstration that qualitative aspect of intellectual performance is fully as important as quantitative variations.

Reviews

The most significant review of the field is that of Brody (9) who reviewed some 230 references on intellectual change in normal and psychotic adult populations. Cattell (14) listed forty-four available adult intelligence tests indicating the technical handicaps in the estimation of adult intelligence and suggesting the difference between *fluid* and *crystallized* intelligence where *fluid* refers to relations between both new and old fundaments and *crystallized* to habitual responses. Miles (44) and Miles and Miles (45) gave a provocative survey of the psychology of the aging process. Bijou (7) reviewed nineteen references on the usefulness of the concept of test pattern, and Buxton (13) reviewed the status of research in reminiscence (improvement in recall without practice after original learning) indicating that no reliable evidence exists that reminiscence is related to age, sex, or intelligence of the learner. Wechsler and the related discussion by Shakow (60) implied that intellectual changes parallel physical changes albeit the components used to measure intellectual changes decline at different rates, but that drive, persistence, and experience are significant aspects of intellectual performance.

Tests of Adult Intelligence

Using the 1916 Stanford-Binet, Roe and Shakow (56) investigated the pattern of success on the various items of the test implying that in severe psychosis the vocabulary score is a better indicator of previous or original

endowment than the total Stanford-Binet score, but clearly indicating, nevertheless, that vocabulary is far from an adequate index of original endowment since vocabulary score is far below the level of previous education. Rautman (54) using 1937 Form L Stanford-Binet on the institutionalized mental defectives with IQ's under 80 showed age differences on various items. He indicated reliable differences in favor of older mental defectives on vocabulary, definitions, picture identification and comprehension, and in favor of younger mental defectives in identifying parts of body, picture comparison, commands, bead chains, mazes, and so forth. Gerstein (20), on Stanford-Binet Form L, indicated that for adult prisoners several tests seem to be misplaced; the vocabulary is too easy and the abstract reasoning tests too difficult.

The Bellevue-Wechsler is coming into considerable use. Mitchell (47) reported a correlation of .89 for mental hospital patients between the Wechsler and the Stanford-Binet Form L, indicating that older patients attain higher IQ's on the Wechsler, and that duller patients also attain higher IQ's on the Wechsler. Benton, Weider, and Blauvelt (6) reported a correlation of .93 between the same two tests with conclusions similar to those of Mitchell; they also gave a table of equivalents between the two tests based on a regression formula. Milton (46) suggested a difficulty in the standardization of the Wechsler test in that altho drug addicts score lower than norm in seven of the ten subtests, their full weighted score is higher than the norm. Rabin (52) suggested a short form of the Wechsler made up of Comprehension, Arithmetic, and Similarities which correlate .93 with the full Wechsler scale for two hundred psychotics and .80 with the full Wechsler scale for ninety-two normals; he also reported for normals a correlation of .74 between the full Wechsler and Army Alpha.

The standardization of the Shipley-Hartford Retreat scale is described using the ratio of abstract MA based on twenty completion-type items involving induction and deduction to vocabulary MA based on forty multiple choice vocabulary items (57). Slater (58) reported a correlation of .51 between the Shipley vocabulary and abstraction scores and gave tables for interpreting the difference between the two scores. Halstead (23) has applied the Shipley and Raven's Progressive Matrices to seven hundred neurotic military subjects.

Raven (55) discussed the standardization of the Progressive Matrices and showed that the scores are higher for his test given as a group test than when given as an individual test. Bradford (8) used the Raven Progressive Matrices as a selective device and then used performance tests for diagnosis; he gave detailed instructions for his adaptations of the Alexander Passalong, Kohs's designs, and a new series of graded form boards.

Many of the new tests are designed to give rapid estimation of intelligence, such as Brown's giving the squares of numbers (12), and Hayman's serial subtraction of 7 from 100 (26, 27) which was standardized on 433

school children. Hayman reported a correlation of .70 with the Babcock Efficiency Index and of .80 with the Shipley. Koenig and Smith (37) reported the use of the Kent E-G-Y, and Lewinski (38) reported the correlation between the Kent and the verbal tests of the Wechsler as .72. Benton (5) showed that the Kohs's Block designs scored according to Hutt vary with amount of education, age, and sex in a sample of young adults.

Hebb and Morton (30, 31) announced the McGill Adult Comprehension examination based on verbal situations and on picture anomalies. Hebb (28) reported a correlation corrected for attenuation of .63 between the Picture Anomaly Series and the 1916 Stanford-Binet vocabulary. Wittman (62) announced the Elgin Initial inventory together with the Elgin test reaction scale showing psychograms on individual subtest performance with age. Wells and Savage (61) announced the modification of Army Alpha to increase the scope of alpha procedure in estimating intellectual organization in terms of Thorndike's speed range and altitude. Penrose and Myers (49) referred to the General Examination-M (Canadian Psychological Association for the Department of National Defense).

Halstead (24) investigated eighty tests in relation to senescence of which twenty-five were selected as a tentative battery. He showed that senile adults find difficulty in reversing old habit sequences, in retention of meaningful auditory and visual stimuli, in judgment, in planning, and in spatial discrimination, while they are better in rote memory and fluency of old associations. Esher (18) reported his experience in testing dull military personnel as evidence that the age effect is marked in men of lower levels of intelligence and probably less marked among the most intelligent. Heston and Cannell (33) administered the Stanford-Binet Form L vocabulary, Knox cubes, Porteus mazes, and Ferguson form boards to members of borrower families of the FSA. The intercorrelation among the tests ranged from .23 to .44, and the correlation of the median mental age with highest school grade of .50. In relation to age, the vocabulary scores showed rapid rise from fifteen to twenty years, and persistent rise to age fifty-five, and on the other tests a rapid decline beginning in the thirty's, altho the decline on the Knox cube began at age seventeen.

Mental Efficiency and Mental Deterioration

Goldstein and Scheerer (22) described and gave the basis for interpreting the Goldstein-Scheerer Cube test, Gelb-Goldstein Color Sorting test, Gelb-Goldstein-Weigl-Scheerer Object Sorting test, Weigl-Goldstein-Scheerer Color Form Sorting test, and the Goldstein-Scheerer Stick test. These tests are designed to evaluate *qualitatively* the concrete versus abstract "attitude" of the subject. They contend that abstract "attitude" is distinctly different behavior from concrete. In frontal lobe damage (21), patients do not suffer defects of mental function as much as damage in "attitude" resulting in lessened initiative, foresight activity, and in im-

pairment in voluntary shifting and choice. Hebb (29) showed little change in psychometric performance before and after brain injury, but suggested that age at which brain injury occurs may affect mental organization. Goldstein (21, 22) criticized Hebb from point of view of the quality of the performance rather than the quantity of score. Hanfmann and Kasanin (25) described the Vigotsky Concept Formation test, confirming Vigotsky's thesis that conceptual thinking is impaired in schizophrenia, and Zubin and Thompson (64) reviewed and described these sorting tests in relation to drug therapy.

The concept of qualitative change relates to how the score is obtained rather than to the amount of total score. For instance, Cleveland and Dysinger (15) reported that the majority of institutionalized senile psychotics sort objects on a concrete basis, and while they respond to the verbal items on the Wechsler, they are responding in terms of concretized restricted meanings so that the two tests are relatively independent. Myers and Gifford (48), using the psychometric pattern approach, scored each item on the 1937 Stanford-Binet for difference between schizophrenia and matched nonpsychotic controls. The significant finding is that as people grow older they approach the schizophrenic pattern more closely in the age range fifteen to fifty-five years. Magaret (41), however, warned against the incautious use of psychometric test pattern even though some of the Wechsler tests are sensitive to increasing age, and (42) reiterated this caution. Brody (10) made a quantitative appraisal of test scatter in relation to dementia and (11) concluded that in "normal senility, although cognitive deterioration may be as severe as in dementia, the affective conative deterioration is proportionately much less. . . ." Rabin (50, 51) used test-score pattern on the Wechsler to differentiate psychotic and nonpsychotic patients but cautioned against its routine use. He found the ratio of the sum of Information, Comprehension, and Block Designs to Digit-Symbol, Object Assembly, and Similarities 1.00 for normals and 1.27 for schizophrenics.

Fleming (19) described the introduction of the Shipley in England and Zangwill (63) described three unstandardized tests of memory impairment; he modified Wechsler's Digit-Symbol, Babcock's sentence repetition, and the Rey-Davis peg boards as learning tests which show two different forms of impairment, organic and neurotic.

Developmental Limits and Intellectual Status

Anderson and others (1) showed for 112 college freshmen the correlation between point averages and Wechsler, 1937 Stanford-Binet, 1940 ACE, and 1941 ACE to be about .50 to .55, but that the Wechsler performance scale correlates with the tests from .19 to .39 implying apparent invalidity of the performance scale. Barnes (2) showed that college students after two years of instruction are still making gains on the ACE, particularly on the L score. Lorge and Blau (40) showed that on an identical

population tested at age fourteen, twenty-five, and thirty-four, the reading comprehension increases from fourteen to twenty-five and declines somewhat between twenty-five and forty. R. L. Thorndike and Gallup (59), thru the Gallup poll, administered a sample of the vocabulary of the CAVD test and found some decline on vocabulary from age twenty to sixty with medial adult performance equivalent to an Otis MA of sixteen years. Lorge (39) pointed out the fact of a negative relation of age to highest school grade reached and showed the correlation of age to highest school grade reached as $-.22$, $-.22$, $+.10$, and $-.39$ for samples of males and females in the age range twenty to seventy. The corresponding correlations of age to Otis scores were $-.38$, $-.43$, $-.20$, and $-.20$ suggesting the correction of education on level of intelligence of adults. Benson (4) showed that childhood intelligence is related to highest grade reached: the median IQ for those that did not enter high school was 95; for those that went to high school but did not graduate, 108; for those that were graduated from high school, 120; and so on. Kaplan (34) in studying institutional morons showed that over an average interval of fifteen years, they lose over six-and-one-half MA months on 1916 Stanford-Binet while remaining relatively constant in vocabulary. Rautman (53), studying the follow-up test pattern of mental defectives, showed a relationship between Babcock Efficiency Index and measured changes on the repeated administration of the Stanford-Binet.

Studies of General Interest

McGeoch (43) reviewed learning as a function of age. Doll (16, 17) showed the relationship of the Vineland Social Maturity Scale to age. Kingsley and Ankeny (36) showed adults more efficient in goal-searching. Hebb (32) pointed out that intertest correlations are lower, particularly with advancing age. Kennard and Fulton (35), studying cerebral insult in monkeys and chimpanzees, concluded that the factor of age affects directly the amount of recovery of motor functions—there being little recovery if ablation is made after second year of life. This suggests that the “sensory motor cortex may be considered . . . as a unit within which there is much less specificity of function in the infant than in the adult.” Baxter (3) has continued his work on the relationship of time-limit and work-limit methods.

Cautions

The tendency to use short tests without adequate consideration of reliability or of consistency may be responsible for overgeneralizations concerning the factorial composition of tests. It must also be recognized that most tests of adult intelligence are inadequately standardized or normed. Too frequently the normal control represents a special population, e.g. nurses, hospital attendants, and so forth, and the factor of education definitely is related to test score or performance.

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- Dolch, E. W.**, Assistant Professor of Education, University of Illinois, Urbana, Illinois.
- Donohue, Francis J.**, Assistant Professor of Education, University of Detroit, Detroit, Michigan.
- Douglas, Harl R.**, Director, College of Education, and Chairman, Psychology Department, University of Colorado, Boulder, Colorado.
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† Elected to membership beginning January 1, 1945.

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- Durost, Walter N.**, Personnel Research Technician, A.G.O., War Department, 270 Madison Avenue, New York, New York.
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- Eads, Laura Krieger**, Research Assistant, Bureau of Reference, Research, and Statistics, New York City Board of Education, Brooklyn, New York.
- Easley, Howard**, Lieutenant, U. S. N. R., Naval Communications, Navy Department, Washington, D. C. (Assistant Professor of Educational Psychology, Duke University, Durham, North Carolina.)
- Eckert, Ruth E.**, Associate Professor of Educational Psychology and Associate Director of Educational Research, University of Minnesota, Minneapolis, Minnesota.
- Edmiston, Robert Wentz**, Director of Practical Arts Education, School of Education, and Director of Extension, Miami University, Oxford, Ohio.
- † **Edmiston, Vivian**, Consultant, Teacher Education Study, State Teachers Association of Colleges and Universities, Syracuse, New York.
- Edmonson, James B.**, Dean, School of Education, University of Michigan, Ann Arbor, Michigan.
- Edwards, Newton**, Professor of Education, University of Chicago, Chicago, Illinois. (President of A. E. R. A., 1943-44.)
- † **Ellenoff, Louis**, Instructor, Social Studies, Haarem High School, New York, New York.
- Ellingson, Mark**, President, Rochester Institute of Technology, Rochester, New York.
- Elliott, Eugene B.**, State Superintendent of Public Instruction, Lansing, Michigan.
- Emens, John R.**, Director of Personnel, Board of Education, Detroit, Michigan.
- Engelhardt, N. L.**, Associate Superintendent of Schools, New York, New York.
- Engelhardt, N. L., Jr.**, Director of Research, Board of Education, Newark, New Jersey.
- † **Espenschade, Anna**, Assistant Professor of Physical Education, University of California, Berkeley, California.
- Eurich, Alvin C.**, Vicepresident, Stanford University, Stanford University, California. (President-elect A. E. R. A., 1945-46.)
- Evenden, Edward S.**, Professor of Education, Teachers College, Columbia University, New York, New York.
- Farnsworth, Philo T.**, Superintendent of Schools, Granite School District, Salt Lake City, Utah.
- Fattu, Nicholas A.**, College Entrance Examination Board, Princeton, New Jersey. (Instructor, University of Minnesota.)
- Fawcett, Harold P.**, Professor of Mathematics Education, Ohio State University, Columbus, Ohio.
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- Finch, F. H.**, Assistant Professor of Education, University of Illinois, Urbana, Illinois.
- Findley, Warren G.**, Assistant Director, Division of Examinations and Testing, State Department of Education, Albany, New York.
- Flanagan, John C.**, Colonel, A. C., Chief, Psychological Division, Office of the Air Surgeon, Headquarters, A.A.F., Washington, D. C. (Associate Director, Cooperative Test Service, New York, New York.)
- Flemming, Cecile White**, Business and Industrial Personnel Consultant; Special Staff Writer, The Klein Institute, Graybar Building, New York, New York.
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† Elected to membership beginning January 1, 1945.

- Fowlkes, John Guy**, Dean of Summer Session and Professor of Education, University of Wisconsin, Madison, Wisconsin.
- Frederick, O. I.**, Professor of Education, Kalamazoo College, Kalamazoo, Michigan.
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- Fritch, C. Lorene**, Director of Research, Glendale Unified School District, Glendale, California.
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- Froelich, Gustav J.**, Supervisor of Records, Department of Education, University of Chicago, Chicago, Illinois.
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- Garrison, S. C.**, Professor of Psychology and President, George Peabody College for Teachers, Nashville, Tennessee.
- Garver, F. M.**, Professor of Elementary Education and Director of Reading Clinic, University of Pennsylvania, Philadelphia, Pennsylvania.
- Gates, Arthur I.**, Professor of Educational Psychology, Teachers College, Columbia University, New York, New York. (President of A. E. R. A., 1942-43.)
- Gerberich, J. R.**, Director, Bureau of Educational Research and Service, University of Connecticut, Storrs, Connecticut.
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- Goodykoontz, Bess**, Assistant Commissioner of Education, U. S. Office of Education, Washington, D. C. (President of A. E. R. A., 1939-40.)
- Gordon, Hans C.**, Special Assistant to the Director of Educational Research, Board of Education, Philadelphia, Pennsylvania.
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* Honorary Member.

† Elected to membership beginning January 1, 1945.

- Greene, H. A.**, Professor of Education, and Director, Bureau of Educational Research and Service, State University of Iowa, Iowa City, Iowa. (Secretary-Treasurer of A. E. R. A., 1923-26; President, 1936-37.)
- Greene, J. E.**, Specialist in Research, Georgia Agricultural and Industrial Development Board, Athens, Georgia. (Professor of Education, University of Georgia.)
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† Elected to membership beginning January 1, 1945.

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- Houle, Cyril O.**, Director of Basic and Pre-Medical Phases, Army Specialized Training Program at the University of Chicago. (Assistant Professor of Education, University of Chicago, Chicago, Illinois.)
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- * **Judd, Charles H.**, Consultant on Social Studies, Public Schools, Santa Barbara, California. (Emeritus Professor of Education, University of Chicago, Chicago, Illinois.)
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- Kearney, Leo I.**, Assistant Director, Bureau of Reference, Research, and Statistics, New York City Board of Education, Brooklyn, New York.
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- Kefauver, Grayson N.**, Dean, School of Education, Stanford University, Stanford, California.
- Kelley, Truman L.**, Professor of Education, Graduate School of Education, Harvard University, Cambridge, Massachusetts.
- Kelley, Victor H.**, Commanding Officer, Navy V-12 Unit, Jefferson City, Tennessee. (Director of Appointments, University of Arizona, Tucson, Arizona.)
- Kelly, Fred J.**, Chief, Division of Higher Education, U. S. Office of Education, Washington, D. C.
- Kemmerer, W. W.**, Comptroller and Director of Curriculum, University of Houston, Houston, Texas.
- Keys, Noel**, Professor of Education, University of California, Berkeley, California.
- Kinney, Lucien B.**, Acting Dean, School of Education, Stanford University, Stanford University, California.
- Knower, Franklin H.**, Associate Professor of Speech, State University of Iowa, Iowa City, Iowa.
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- Kramer, Grace A.**, Baltimore Public Schools, Baltimore, Maryland.
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- Larson, Emil L.**, Professor of Education, University of Arizona, Tucson, Arizona.
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- Lovejoy, Philip**, Secretary, Rotary International, Chicago, Illinois.
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- Maaske, Roben J.**, President, Eastern Oregon College of Education, La Grande, Oregon.
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- McClure, Worth**, Superintendent of Schools, University City, Missouri.
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- Masters, Harry V.**, President, Albright College, Reading, Pennsylvania.
- Mathews, C. O.**, Professor of Education, Ohio Wesleyan University, Delaware, Ohio.
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- Merriman, Curtis**, Registrar, University of Wisconsin, Madison, Wisconsin.
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- Mochlman, Arthur B.**, Professor of School Administration and Supervision, University of Michigan, Ann Arbor, Michigan; and Editor, *The Nation's Schools*. (President of A. E. R. A., 1928-29.)
- ** Monroe, Walter S.**, Director, Bureau of Educational Research, University of Illinois, Urbana, Illinois. (President of A. E. R. A., 1916-17; Editor of *Encyclopedia of Educational Research*, 1941.)
- Moon, Robert Cary**, Director of Intern Teaching, Florida State College for Women, Tallahassee, Florida.
- Moore, Clyde B.**, Professor, School of Education, Cornell University, Ithaca, New York.
- Moore, Joseph E.**, Captain, Personnel Consultant, Fourth Service Command, Atlanta 3, Georgia. (Professor of Psychology, Georgia School of Technology.)
- † Morgan, Barton**, Head, Vocational Education Section of the Experiment Station, and Director of Teacher Education, Iowa State College, Ames, Iowa.
- Mornewick, Carl D.**, Chief, Division of Child Accounting and Research, State Department of Public Instruction, Harrisburg, Pennsylvania.
- Morphet, Edgar L.**, Director of Administration and Finance, State Department of Education, Tallahassee, Florida.
- Morrison, Harriet Barthelmess**, Consulting Psychologist, Derry, New Hampshire.
- Morrison, J. Cayce**, Assistant Commissioner for Research, New York State Education Department, Albany, New York. (President of A. E. R. A., 1929-30; Editor of *Review of Educational Research*, 1943-46.)
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^{oo} Life Member.

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- Odell, C. W.**, Associate Professor of Education, University of Illinois, Urbana, Illinois.
- Ojemann, R. H.**, Associate Professor, Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.
- Olson, Willard C.**, Director of Research in Child Development and Professor of Education, University of Michigan, Ann Arbor, Michigan.
- Oppenheimer, J. J.**, Dean of College of Liberal Arts, University of Louisville, Louisville, Kentucky.
- Orleans, Jacob S.**, Associate Professor of Education, College of the City of New York, New York, New York.
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